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THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S., &c.

VOLUME XVII.—1868.

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THE CHEMICAL NEWS.

VOLUME XVII.

No. 422.—January 3, 1868.

ON THE MANUFACTURE OF GLASS FOR VESSELS EMPLOYED IN CHEMICAL RESEARCHES.

By Professor J. S. STAS.

In my researches "*on the Reciprocal Relations of Atomic Weights*" I have stated that the ordinary glass of which retorts, flasks, &c., are made, gives up to nitric and hydrochloric acids at the ordinary temperature traces of the metals it contains. In such vessels it is impossible to evaporate the purest acid to dryness without leaving a saline residue. Hard Bohemian glass, known as *refractory*, and in general all glasses having no alumina, and containing an excess of silica, resist for an almost indefinite time the action of hot concentrated acids; but the manufacture of balloons, flasks, and retorts in refractory glass presents great difficulties, the most skilful workmen not being always able to work in it when articles are required of an extra large size. I have had this difficulty frequently brought before me.

Wishing to ascertain what should be the composition of glass which would be at the same time unaffected by acids and sufficiently fusible to be manipulated with no great difficulty, I decided to carry out some experiments on this manufacture in an actual glass house. These researches showed me that a glass having for bases sodium and calcium, if it contains a sufficient excess of silica, resists acids almost as well as refractory Bohemian glass, having for bases potassium and calcium. But it is known that a mixture of equal molecular weights of the carbonates of sodium and potassium is much more fusible than the most fusible of either carbonate by itself; starting from this fact, I have been led to the endeavour to replace, in the composition of refractory glass unattacked by acids, a portion of the potassium by an equivalent quantity of sodium. The result has completely verified my anticipations.

I started from this fact, that to obtain a glass very refractory and unattacked by acids, having for bases potassium and calcium, it should contain about—

Silica	75·00
Oxide of potassium	15·00
Oxide of calcium	10·00
	100·00

Upon replacing in such a glass half of the potassium by its equivalent of sodium, we have—

Silica	77·00
Oxide of potassium	7·70
Oxide of sodium	5·00
Oxide of calcium	10·30
	100·00

In this glass the bases are in the proportion of one atom of calcium ($Ca'' = 40$) to one atom of potassium and one atom of sodium.

With these data I made some trials on a manufacturing scale; using for this purpose fine, pure sand employed in the manufacture of crystal glass, monocarbonate of potassium as pure as it comes from the English works, purified bicarbonate of sodium, and carbonate of calcium in the form of white marble, finely pulverised and passed through a silk sieve. These materials, in appropriate quantities, were intimately mixed with ten or twelve per cent of their weight of arsenious anhydride, and were then submitted in very refractory crucibles to a heat strong enough to bring them to a sufficient state of fusion to enable the glass to be worked. The addition of this enormous quantity of arsenious anhydride was made by the superintendent of the glass works, with the object of more readily determining the liquefaction of the mass. I confess I cannot understand the action of this; it produced, however, no other inconvenience than filling the air with torrents of poisonous matter, and analysis has satisfied me that no trace of the arsenic employed remains in the glass produced.

Operating with the proper proportions, two meltings were effected upon tolerably large quantities. With the glass obtained I had balloons with long necks, matrasses, small flasks, cylinders, &c., blown. The largest balloon which an excellent workman succeeded in making held about four litres; the capacity of the other balloons varied from one to three litres. The sides of the sphere were kept thick enough to be able to resist the traction to which the glass would be exposed by the shrinking experienced by nitrates when solidifying after fusion.

This glass had a yellowish reflection; it was excessively hard, but little elastic, and as free from hygrometric properties as the best refractory glass of Bohemia.

I took the trouble to submit to analysis some fragments of two balloons from different batches; these balloons were broken after having been used for my experiments. They contained—

Silica	76·4	77·3
Oxide of potassium	7·1	6·2
Oxide of sodium	5·9	6·5
Oxide of calcium	10·6	10·0
	100·0	100·0

In these analyses I determined directly the silica, and the oxides of potassium and calcium. The oxide of sodium was estimated by difference. The glass also contained a little alumina derived from the crucible; I did not weigh it; the numbers for the sodium are therefore that much in excess.

ON THE ESTIMATION OF CARBONIC ACID IN MINERAL WATERS.

By Professor FRESENIUS.

When ammoniacal solution of chloride of calcium or barium is mixed with carbonic acid, the metals are not precipitated immediately in the state of carbonates. The author formerly stated that this was due to the previous formation of carbamate of ammonia, whilst M. Carius attributed it to the solubility of the precipitated carbonates in sal-ammoniac. The author has repeated several experiments in support of his view of the case; when chloride of calcium is added to a freshly prepared solution of carbonate of ammonia, the liquid is at first clear, but gradually becomes turbid. If the solution has been made about half an hour, the precipitate forms immediately.

To an ammoniacal solution of chloride of calcium, add twice its volume of water charged with carbonic acid, and it remains clear for a quarter of an hour; after twenty hours the precipitation was not complete and the filtered fluid immediately precipitated with a diluted solution of carbonate of ammonia. A diluted ammoniacal solution of chloride of calcium was treated by a current of carbonic acid for five minutes; it did not become turbid at once. When two drops of a solution of carbonate of ammonia, in 20 parts of water, were added, the first precipitate dissolved when agitated, but a third drop rendered it permament.

Dr. Fresenius concludes from these experiments that there is at first a formation of ammonical carbamate, which only changes slowly into carbonate; this transformation is rendered very rapid by heat. The presence of chloride of ammonium has no influence in these phenomena.

ON A NEW PROCESS OF

ELEMENTARY ORGANIC ANALYSIS,

FOUNDED ON THE ANALYSIS OF THE GASEOUS PRODUCTS.

By M. F. SCHULZE.[*]

Burn the substance to be analysed with chlorate of potash in a tube, having previously sealed and exhausted it; then submit to analysis the gaseous mixture produced. The advantage of this method is the small amount of material necessary; the analyses cited as examples were performed with from 5 to 13 milligr. of matter. M. Schulze introduces the mixture, together with rather more than enough chlorate for complete combustion, into a combustion tube, sealing it at one end, and drawing it out of the other; after having exhausted and measured the pressure of the remaining air, he seals the tube, shuts it up in a gun barrel, and heats it to a dull red heat for twenty minutes. When cold, he breaks the point of the tube under mercury and collects the gas in a eudiometer. By measuring the quantity of carbonic acid formed, and absorbing it by potash, are to be found all the elements necessary for the calculation of the composition of an organic matter containing only carbon, hydrogen, and oxygen. If the carbon absorbs its proper amount of oxygen, and the compound is a body corresponding to a hydrate of carbon, such as starch, the gaseous material obtained is exactly equal to the amount of oxygen supplied by the chlorate of potash used. If more gas be found, it is because the body contains more oxygen than is needed to burn all its hydrogen; if, on the contrary, there is less gas, it is because the body contained an excess of hydrogen with respect to its oxygen in the constitution of water. 5.5 milligr. of cholesterine, burned with 60 milligr. of chlorate, gave (after allowing for the air remaining in the tube) 9·6667 c.c. of gas (at 0° under one metre pressure). The 60 milligr. of chlorate furnished 12·483 c.c. of oxygen; the difference, 2·8177 c.c., is the quantity of oxygen corresponding to the quantity of hydrogen which was not burnt by the oxygen belonging to the cholesterine. Again, 2·8177 c.c. of oxygen burns 0·6664 milligr. of hydrogen (say 12·1 per cent.) The amount of gass aborbable by potash is 16·566 milligr. of carbonic acid, corresponding to 4·518 milligr. of carbon, say 82·145 per cent. The complement, that is to say

$$100 - (12{\cdot}1 + 82{\cdot}145) = 5{\cdot}775,$$

corresponds to the water formed by the oxygen in the cholesterine, and a part of its hydrogen, say 5·133 per cent. of oxygen and 0·639 of hydrogen; on adding this last number to 12·1, there remains 12·74 per cent of hydrogen. [These numbers, compared with those calculated from the composition of cholesterine,

$$(\mathrm{C} = 83{\cdot}8;\ \mathrm{H} = 11{,}8;\ \mathrm{O} = 4{\cdot}3)$$

do not appear satisfactory.] In the combustion of azotised matters, nitrogen may be obtained (after an estimation of the carbonic acid) by absorbing the oxygen with a stick of phosphorus, but the results are not very correct. As to chlorinated matters, the author effects their combustion with oxide of mercury; the chlorine remains in the condition of a mercurial chloride, in which it may be estimated by decomposing the chloride by potash.

ON THE ESTIMATION OF LEAD BY PRECIPITATION IN A METALLIC STATE.

By M. F. STOLBA.

To estimate lead by this method, the author treats both soluble and insoluble lead combinations with zinc in the presence of water acidulated from time to time with hydrochloric acid; the reduction is effected at the temperature of the water-bath in a platinum capsule; the lead is deposited partly on the sides of the capsule and partly on the zinc, whence it is easily dislodged. When the reduction is complete, which is easily discerned by a clean surface of the zinc remaining brilliant in the liquid, decant and wash the spongy deposit of lead with water. As pure water might dissolve small quantities of lead, the author recommends an addition of a drop of sulphuric acid. After washing, dry the lead first in a water-bath, then at about 200° C. Even then its exact weight cannot be ascertained because it has undergone a partial oxidation. After weighing it, the oxygen absorbed must be ascertained, which may be done by Mohr's volumetric method—namely, by treating the lead with a weak standard solution of nitric acid. Wash the dissolved oxide of lead, and add a standard alkaline solution until it begins to produce turbidity. The quantity of oxide of lead is given by the difference in the standard of the nitric acid before and after its action on the lead.

Explosive Powder for Blasting Rocks, &c.—Experiments have recently been made in a cutting for a tunnel at Milford between Nobel's nitroglycerine and the explosive powder which is manufactured, wirhout danger of decomposition a spontaneous explosion, by Mr. Horsley. The preference was given to the powder not only for its power when exploded in a particular kind of cylinder, but alas for its economy, and its greater safety in use and storage. It requires a temperature of 475° to ignite. It has been tried and approved by the Admiralty, and is much liked by miners, who say they are afraid of blasting oil, and think gun-cotton useless.

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[*] *Zeitschrift fur Analytische Chemie*, t. v., p. 239.—*Zeitschrift fur Chemie*, nouv. ser., t. iii, p. 391.

ON

HEAT AND COLD;

A COURSE OF

SIX LECTURES*

(Adapted to a Juvenile auditory),

DELIVERED AT
THE ROYAL INSTITUTION OF GREAT BRITAIN,
(CHRISTMAS, 1867–8),

BY

JOHN TYNDALL, ESQ., LL.D., F.R.S.

LECTURE I.

The nature of heat, and the various modes of generating it.—Friction and combustion.—Changes of volume produced by heat.

I wished very much indeed to be able to write out notes of these lectures in order that you might take those notes home with you, and that they might help you to remember what I spake here. But I have been so very, very busy with other matters—so very hard at work—that I have found it perfectly impossible to write out and to get printed those notes which I now refer to. In fact, I wished very much indeed to avoid giving this course of lectures altogether, in consequence of the heavy labours of another kind that I have been engaged in, but, however, some friends of mine said that the boys and girls here present would take it very unkindly of me, and would think that I was neglecting them if I did not come forward and give this course; and inasmuch as this is a thing I did not wish you to think of me, I thought it best to come forward and to do the best that I can under the circumstances. Of course your not having those notes to bring things back to your minds will render it all the more necessary on your part to give me the utmost possible attention, to endeavour to understand all I say,—and indeed at the very starting I shall have to bring some very difficult matters before you that will require a concentration of attention on your part. But I calculate—and I know I can calculate with confidence—upon your attention; and if you give me that attention, as I am sure you will, I have no doubt we shall get on, on the whole, exceedingly well together. (Applause).

Now, I suppose all of us twenty times a day—perhaps more—make use of the word "*I*." Every boy here present says, "I eat," "I drink," "I sleep," "I feel;" but perhaps very few boys or girls either ever ask themselves, "Who is this *I* that does all these things?" and if you went to the biggest man in the world, or the greatest philosopher, you would puzzle him exceedingly if you asked him "Who is this *I* that sleeps, and drinks, and eats, and feels?" In fact, philosophers, great as they may be—and great they are—find that there are things altogether beyond their knowledge and beyond their power to understand, and this wonderful human *I* is one of those things. Hence, I do not want you to be able to answer me if I ask, Who is this *I*—what is this *I*—that sleeps, and drinks, and eats, and feels, and makes use of its senses? In fact, as I have said, the best of us know very little about it; but we know a great deal of that peculiar instrument by which the *I* operates upon the world, and by which it understands the things that are going on in the world, and that instrument is the wonderful human body. When we examine that body, looking into its interior parts, we find bones and blood and muscles and tissues of various kinds; and passing through these muscles we find strings of whitish matter—strings going from the spinal marrow, and going from a mass of matter that rests in this wonderful cavity called the head. I say those strings of white matter go through the body, and they are called the *nerves*: and it is by the intervention of these nerves and this wonderful brain that we human beings are able, so to say, to hold converse with the world round about us. Now, these nerves transmit the impressions from without. If I prick my finger a nerve is effected; it is lacerated by the pricking of the pin or the penknife, and that nerve thus lacerated sends intelligence through itself up along the arm to the brain; and until it arrives at the brain you do not feel anything. It travels up to the brain at the rate of about 180 feet in a second. This is one of these wonderful things that have been measured by able men. You do not feel the exact moment your finger is pricked.

Now, what the nerves in all these cases convey to the brain is something in the nature of motion; and in order to enable you to form an idea of this motion I have arranged a little experiment. And here I must call upon that power which every boy and girl here possesses—that wonderful power which is sometimes called "imagination"—the power of picturing things before the mind. I would ask you to picture one of these nerves going through the body to the brain; and I would ask you to figure that nerve burned, we will say. Now, how are you to conceive of this nerve? The nerve is made up of very minute particles to which we give the name of "molecules" or "atoms." They are sometimes called atoms. In fact a molecule is an aggregate of atoms. But what I want you to clearly realise, and which is perfectly in your power to realise, is that these nerves are composed of little particles—(I do not care about the name, whether "atoms" or "molecules"); and if you disturb the end of any nerve—if you burn it—if you prick it—what you do there is that you impart *motion* to the body. This motion runs along the nerve, and when it reaches the brain it declares itself in some form—of pain, or, it may be, of pleasure. Now, how is this done? You may, in fact, consider those nerves to be like the telegraphic wires that go through the streets. You have seen them passing through the air of London; and these telegraphic wires carry messages to and fro through various parts of London. I say, you may consider the nerves as being represented by those telegraphic wires, and you may consider the brain a great central station, so to say, with which the nerves communicate—to which they communicate their messages, and from which they receive their messages. In order to make this plain I have have here arranged a little experiment—very simple indeed. You can make it yourselves with the glass balls used in the game of solitaire. You see I have there a series of these balls, and I want to enable you by these balls to conceive how motion is propagated through the nerves. There is nothing shot through the nerves: the motion is communicated from particle to particle. Observe, here. If I take hold of this ball and strike it against the first ball of this series, you will observe what occurs. The motion will be transmitted through all the series of balls. Each ball will take up the motion given to it by the preceding one, and pass it on to its neighbour, and thus the motion will go through the entire series so that the last ball of the series will be the only one affected. Observe how the last ball is detached. There it goes away. The moment I hit this first ball the terminal ball flies off. Now, in some such way—in a way somewhat analogous to this—is motion propagated to the brain. Allow this bell to represent the brain. Now, if we take our series of balls thus, and strike, as I have said, the first ball, the blow will be communicated to the terminal ball, and that, liberated, will strike against the bell. The sound of that bell is something like a signal given in the brain. [The bell was sounded in the manner indicated.] Here you have the motion transmitted from the first ball, and finally the bell is thus affected. In the way somewhat rudely and roughly represented by this experiment the motion is transmitted to the brain, and when it reaches the brain it evidences itself, as I have said, as pleasure or pain, as the case may be.

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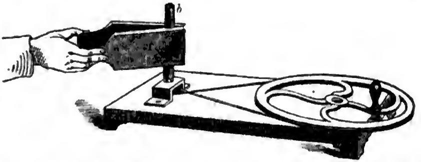
* Reported verbatim, by permission of the Author, for this journal.

Now, having exercised your imagination upon those particles which I have called atoms or molecules, I think we may go on to consider the character of this power that we have to deal with in this course of lectures; that is, this thing that we call "heat." Long reflection and many experiments on this important subject have caused men of science—learned men who investigate such things—to the notion that this thing that we call beat is a kind of motion. And now I should like every, even my youngest hearer—(and that is a large demand)—to figure, by this power of imagination, what I describe. Take any substance,—for instance, this body which I hold in my hand. This, like our nerves, is composed of little particles or atoms. It is not absolutely cold at the present time. Of course it may feel cold to my hand, but it is really not cold. Those particles that I have been speaking of are in a state of motion. Although they are too small to be seen, and although the motion is entirely too small to be seen even by our best microscopes, still we have every reason to believe—the very strongest reason to believe—that the particles of that body at the present time are vibrating. The little particles, remember—(picture them to your mind)—are vibrating to and fro; and the warmer the body is, the more intense is this motion; and, in point of fact, it is this motion of the smallest particles of the body to which, when communicated to the nerves, and through the nerves to the brain, we give the name of heat. Now, although I am dealing with some of the deepest things in science, still I expect all the boys and girls here to clearly figure to their own minds this substance as an assemblage of small particles, and those particles oscillating—vibrating; and the warmth that I feel when I take this in my hand is due to the multitude of these small motions that are going on within the body.

Fig. 1.



Well, now, this motion of the particles of a body can be excited in various ways, and one of the most ordinary ways of exciting it is by friction. If you take, say a flat brass button, in your hand, and if you rub this button upon a surface of wood, as I am doing this which I hold in my hand, very soon, by rubbing this body [a short rod of metal] I make it so hot that I don't like to bear it against the skin of my face. In point of fact, the friction exerted against this substance produces the motion we call heat, and I very nearly burn myself. The rubbing throws the particles into this furious motion. If I place this body, before rubbing it, upon a flat piece of white wax, there it stands; but let me rub the end of the piece of metal for a time, thus, and then place it upon the wax, you observe it runs away; it melts the wax underneath it, and slides down in this way. This body [a similar short rod of metal] which has not been rubbed, will never melt the wax, and there it rests. The sliding of the other piece of metal is due to the heat produced by the friction. And in various other ways heat is produced by friction. For instance, if you take a saw, and pass that saw through wood, if you are careless and do not put grease upon the saw, then there is so much friction that the amount of heat developed in the saw becomes very great indeed. The saw becomes quite hot. And that is the theory and that is the reason why carpenters grease their saws when they use them. They do not want to make heat, for when this friction is overcome you actually *create* heat. Now, the carpenter is not anxious to make heat; he wants to get through the wood, and he wants to get through it with the least possible trouble; and, in consequence, he lessens the heat by putting grease upon the saw; he makes it as smooth as possible.

In this way, then, that is, by means of friction, we can actually generate, produce, create, this thing we call heat—this motion; and that is a very important point. It was thought for a long time impossible that heat could be generated. It was supposed that there was a certain quantity of heat in the universe, and that this was perfectly constant, no change occurring in it; but you see we have simply to produce this motion of the particles, and then that motion we call heat is set up. I have here an experiment that will still further illustrate this. When I was a boy—and I suppose I was like the average of boys—I was very fond of savages, and people of that kind. Now, I should like immensely to be able to transform myself into a New Zealand savage for the next five minutes. If I could do so I should be able to make a very beautiful experiment which it is not now in my power to do, for I am not so clever as those savages. My friend, Sir John Lubbock, who is a very great man on savages, has given me these two sticks. These are the genuine articles, brought from Australia. This stick is made of a particular kind of wood, pithy, and rather soft; and you see there are holes in one of the pieces of wood. This second stick is made of a harder material. Now, one of these native savages takes one stick and places the end of it in one of the holes of the other stick. He then clasps it, thus, and by the friction he uses he causes a little dust, first of all at the end. He works on until that dust takes fire; and then he manages by blowing, and by operating with far more skill than I can bring to bear upon the experiment, to actually produce flame. These are the very articles used by these New Zealand savages when they wish to produce fire by friction.

Well, I can illustrate still farther this mode of producing heat. I have here, you see, a hollow tube, *b*, and I will place in this tube a quantity of a certain liquid which boils a little more readily than water. I might take water, but I will make use of ether for the purpose of making the experiment more rapidly. Now I will try whether I can not boil that liquid by friction. You see after putting the ether into the tube I cork it up thus, and then fix the tube on this instrument which is called a whirling table, and by means of which I can cause the tube of liquid to spin round with great rapidity. The tube is now fixed firmly upon the whirling table, and we will there spin it rapidly round and round. I could boil that ether by simply clasping the tube in my naked hand. I have done so over and over again. The friction of my hand against this tube has been sufficient to boil this ether, but I have found it very hot and very unpleasant; and in order to protect my hand I will take a piece of flannel, and grasp the tube tightly with the flannel round it. Now, I want you to observe that if the experiment succeeds—(and experiments are always liable to fail)—the friction of the flannel against the tube which goes round and round will cause the ether to boil, and when that happens the steam of the ether underneath the cork will project the cork into the air. I want you now to observe the cork while I clasp the tube in the flannel. [In the course of a few seconds the cork flew from the mouth of the tube.] There it is, you see. Look at that!—boiled in half a minute,—boiled by the friction of that piece of flannel against the tube. Well' now, I have here another tube, and I have here a quantity of metal. Look at it,—hard metal. There it is. Now, I break that metal into bits thus; and I purposely avoided putting it into this tube until now so that you might actually see the metal going in, and see that there is no delusion or mistake about the matter. Now, I will place some of this broken metal in this tube. We can put a little more in afterwards. I have put in as much as will go in now. I expect to be able to melt that metal by friction. I will cork the tube up tightly as in the former case, and when the metal is melted I will pour it out on this plate. [The rotation was commenced.] I am beginning to feel the heat now, and I have no doubt that very soon we shall have the metal in the tube molten. [Examines the contents of the tube.] Yes. I will put in more so as to get a greater quantity melted. I will pour it out presently, but you must first exercise your patience until we get it all melted. I put in as much as the cavity would hold in the first instance. Now, we will work the whirling table once more, and I will clasp it as before. [After a further interval]—Now the tube is so hot that I have no doubt the metal inside is melted. Yes, it is melted. Let us put in a last bit, and thus we shall get back the whole of that cake after it has been liquefied by the friction. I cork up the tube in order to keep the molten metal from splashing about. [The tube was caused to revolve again for a short time, and then detached from the whirling table. The metal was poured out, and found to be completely fused.]

Well, there are various other ways by which this motion that we call heat can be generated. It can be generated by percussion—by hitting with anything hard. For instance, I have here a piece of lead—a lead bullet: if I place this bullet upon an anvil, and strike it in this way, when I take it up afterwards it is too hot to hold, and burns me. I have actually created that heat. I have called that heat into existence. By hitting this bullet I have thrown its particles into this peculiar vibratory motion to which we give the name of heat.

Now, how do we know the precise amount of heat produced by a stroke of this kind? I had intended to make an experiment before you in connection with this point; but you will understand the experiment without my taking up your time to perform it in your presence. Here is a piece of lead, and there I have upon the floor a thick plate of iron. I intended to send one of my assistants to the top of the house, and I intended him to drop this piece of lead down, and let it fall upon this plate of iron. Now, it so happens that the height of this room is such that this piece of lead, having a certain amount of temperature on leaving the hand, would have that warmth augmented by one degree of temperature. I must here make use of the term "degree," although I cannot explain it till the second lecture; but you will remember that by the falling of this piece of lead from the ceiling, upon this plate of metal, we should raise the temperature of the lead one degree Fahrenheit. In like manner, if I sent up this liquid metal, which is called mercury, and had it poured out from the ceiling, and let it come down upon this plate, the mercury in falling from the top of the house to the bottom would have its temperature raised one degree. But if I took water it would be totally different. In this case I should have to go not to a height of 30 feet, but to a height of 770 feet and a little more, in order that the water should have its temperature raised one degree. You will understand this difference between water and mercury and between water and lead, by-and-by. I now wish you to understand that we can tell the exact amount of heat which a shot falling from a certain height can generate or produce; and we should find an increase of heat produced in all such cases if we had instruments of sufficient delicacy. No doubt many of you will see when you grow up that fine waterfall in Switzerland where the river Aar jumps or tumbles down a perpendicular precipice. I suppose it jumps from a vertical height of 400 feet. Well, if you could place a thermometer at the top of that fall, and another at the bottom, the water at the bottom, if the the thermometer were delicate enough, would be found warmer than the water at the top; and knowing the height from which the cataract plunges, we can tell the exact amount of heat generated by its fall downwards, through his power of percussion in developing heat.

When I was a boy instead of using percussion caps, which are now so common for firing guns, they used to employ an instrument of this kind in guns—[exhibiting an old-fashioned gun-lock]. Here is a piece of steel, and this other substance is a piece of ordinary flint which you see moves forward in this way. Now, I can cock that gun-lock, and then by pressing on the trigger I release the hold, and the flint falls against the steel, and you notice the sparks produced. This is a very old lock, and a very bad one; but still you see there are sparks produced when I liberate the flint, and it strikes against this steel. If we put a little powder in the pan beneath the flint we imitate what used to be the method of firing guns in former days. [The lock was then primed.] Now, you see when I let the flint strike the steel the gunpowder is exploded by the sparks produced. In the same way tobacco smokers and others used to get a light by igniting tinder by means of the sparks produced from a flint when struck on a piece of steel.

Now, what is the meaning of this experiment? What is the theory of that gun-lock? It is this. You have seen that when I struck the lead I raised its temperature. A very great man who used to lecture in this room many years ago—Sir Humphry Davy—caused a lock of this kind to go off where there was no air, and when he examined the lock afterwards he found that the flint had struck away little bits of the steel from the part of the lock against which it struck; and when he examined those little bits of steel he found that they had been fused; so that really the percussion of this flint against the steel surface is so strong that it raises those particles of steel which it breaks off almost to a white heat. When steel or iron is thus raised to a high temperature it is affected by a certain substance which is round about it in the air. You must remember the name of that substance, it is so very important. It is called *oxygen*; and when iron or steel is raised to a sufficient temperature, this oxygen instantly attacks it—plunges against it. As before, I must ask you to exercise your imagination with regard to this oxygen. You must figure in your minds this oxygen as very small particles diffused throughout the air. Then, I say, when the iron or steel is raised to a high temperature the oxygen diffused through the air plunges against it, and hits it so hard that there is a kind of percussion. The oxygen hits the iron or the steel so hard as to produce this thing that we call heat, and produce it in such a degree as actually to render the body white hot. Now, I want to show you that this is the case. I have here the means of producing a flame of considerable size; and downstairs we have a pair of bellows. A man has just quitted the room to work those bellows. A current of air will pass through this tube, and we shall obtain here a flame of considerable power. Now, what I want you to understand is this,—that if by means of this flame I heat particles of iron or steel, you will find that those particles of iron or steel will shoot out like stars because of the plunging upon them of the oxygen of the air. Here I have a vessel containing these iron filings, and as I throw them on the flame you see the sparks produced are very brilliant indeed. (Applause). The iron is burned in this way. I have thrown in sufficient of it to illustrate what I have been saying. First of all these particles of iron were heated exactly as in the case of the gun-lock; and when they were heated the oxygen of the atmosphere plunged against them, and plunged against them so violently as to produce these star-like forms which you have seen. Some call this force attraction or chemical affinity; but what I want you to see is this—that these particles of iron when heated to this temperature are showered down upon by the oxygen of the air. This wonderful substance of the air, called oxygen, forms but a small portion of the atmosphere—about one-fifth of it by weight. Hence, if we had the whole atmosphere composed of oxygen those effects of combustion would be very much greater indeed than they are at present. I have here some pure oxygen obtained by proper methods, and I will just ask you to observe how much more powerfully this atmosphere of pure oxygen acts upon a body than does the oxygen in the ordinary air, where it is diluted, as I have said, to a considerable extent. I have here a piece of wood which I set fire to. I blow the flame out then, leaving the end red. You see the air has no power to make it ignite again. If I bring it into the oxygen see what occurs. [The incandescent end of the stick was introduced into a jar of oxygen gas, and immediately burst into a brilliant flame.] The oxygen when it is not diluted has this wonderful effect. And so I might take paper or other combustible bodies instead of this wood. In fact I might use iron. I will produce here a flame from a mixture of oxygen and another gas called hydrogen, and I will cause the oxygen to burn, not a piece of paper or wood, but actually a piece of steel. I hold a piece of steel here in my hand. It is the spring of a watch. A man has now gone down to start the apparatus. I shall very soon have a jet of gas passing through here. I will ignite that jet of gas, and then you will see the flame of the hydrogen,—not a brilliant flame by any means. [A jet of hydrogen was then ignited.] I will presently mix with the hydrogen flame which you see a quantity of this oxygen, but I want first to raise this steel to a very high temperature, and then to allow the oxygen gas to act upon it. I will now throw into this jet of hydrogen a quantity of this wonderful oxygen. You will see that the flame becomes very much smaller; and now it is enormously hot. Observe what it can do with that piece of steel. Observe how it can burn it away. This substance called oxygen is playing upon that spring. If I take away the hydrogen you see no flame whatever, but we have only the pure cold oxygen; but when once the temperature of the steel has been raised sufficiently, the force with which the oxygen particles, or atoms as I called them, plunge down upon the steel is sufficient to produce this wonderful effect. [The watch-spring continued to burn in the jet of oxygen.]

Well now, we have the generation of heat exemplified in this way. I showed you first of all that it could be generated by friction to such an extent that you were able to melt metal with it. I then showed you that it was generated by ordinary mechanical percussion, as in the striking of two pieces of lead by the hammer. And now I ask your power of imagination to help me here in the case of the oxygen uniting with the iron or the steel, which is, to all intents and purposes, a case of percussion. It is, however, a case of the percussion of atoms, instead of the percussion of a hammer descending upon a weight. Now, I think that if you have followed me I have not uttered a word that you can not perfectly understand. You can picture before your mind these little oxygen atoms showering down with this tremendous force upon the surface of the iron; and the object I have in lecturing to you boys and girls is that you may see with the eyes of your mind those things which are too small to be seen with the eyes of your body, and that is the power I referred to in the first instance—the power of imagination.

I have here a variety of jars of this oxygen gas. I do not want to spend too much time in operating with them, but one experiment I must make because it is of such importance and such historic interest in science. The great Sir Isaac Newton, regarding whom a great deal of nonsense and a great deal of wrong has been uttered lately in the newspapers and elsewhere, operated with a diamond in the course of his experiments on optics; and he concluded from his experiments on the diamond that that beautiful gem, the hardest of all substances, was an unctuous, peculiar substance like wax or grease. Long before the experiment was ever made, this Newton by that very power which exists in every boy and girl here present, and which I called upon in the beginning of the lecture, saw that this beautiful gem was a combustible substance; and now I want to show you that Newton was true in his prediction. I have here a small diamond—(for diamonds are very precious, as you know, and it would be a wasteful expenditure, of course, to use a large one); and I will first of all heat it by means of this very hot flame that we possess here. I have there some oxygen gas, and after heating the diamond I will plunge it into the oxygen gas, and I think you will find it will there glow like a little star. Perhaps the hydrogen can not heat it strongly enough, but we will try it. [The heated diamond was lowered into a jar of oxygen.] Yes, there is the diamond burning before you. And now, how are you to figure that diamond? How are you to imagine the state of things going on there? At the present time it is surrounded by oxygen; and the oxygen atoms, as I have called them, are showering down upon the diamond, and showering down upon it with such percussive force as to render it that bright and brilliant star. Now, I think every boy and girl here present can picture before his and her mind what is going on. Imagine these atoms of oxygen showering down upon the diamond, and the force with which they do so raises the diamond to that temperature.

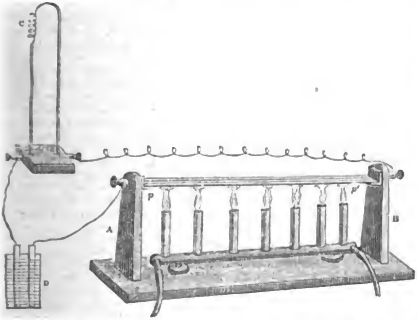
In all these cases heat is actually generated. There is called into existence heat which did not exist before. It is, as I have said, a kind of motion which can be generated in the way which I have indicated.

Having now obtained a general notion as to the methods in which heat is generated, we may pass on for a moment or two to investigate what it can do—how bodies are affected by it.

I have arranged an experiment here, in the front of the table, which will enable you to see what heat can do; and here again I would call upon that wonderful power of imagination. Imagine the particles of a body getting gradually warmer, vibrating with greater and greater intensity. What is the natural consequence? That these particles should force themselves asunder, that the body should become bigger by being heated, that the volume of the body should be augmented by the augmentation of its temperature. Here I have a platinum wire stretched from this stand to this. You observe that at the end I have attached a straw with a piece of paper fastened on it. Here you observe a little wheel, and from that wheel you observe a weight descending. Round the axis of the wheel a platinum wire is coiled. Now the platinum wire is pulling in one direction, and the weight is pulling in the other direction, but if you relax the platinum wire the weight will instantly predominate and the index will rise up. Observe that index rises if I relax the wire by simply pressing this rod to which one end of it is fixed; and when I take my hand away the wire remains no longer relaxed, and the index falls back again. (A great portion of what we call "experimental science" consists of devices of this kind. This was devised by my assistant Mr. Cottrell.) But how shall I heat that wire? By a power which is far away from here, which I hope to be able to talk to you about at some future time. Coming up from the yard beneath there is a power which heats the wire; it is called an electric current. When the current comes the platinum wire will be heated and elongated, and the elongation of the wire will manifest itself on the index. You see this piece of paper smoking with the heat of the wire. If I stop the current, the source of heat is detached, and the wire cools. When the wire cools it contracts, and when it contracts the index falls in this peculiar way.

I have another experiment here to show how heat operates in causing bodies to expand. I have here two bars—one of iron and the other of brass; and at the present time you see here in front of the table a little piece of apparatus the meaning of which you will understand immediately. I will show you that this wire which you see here in front is a little coil of platinum wire. But before I show you this wire I should just like to show you what a power we possess for heating the platinum wire, when we augment our current. This current comes from a battery downstairs, which I trust to have the pleasure of explaining to you, not this year, but perhaps in some future year. Now the assistant will give me a powerful current, and I think you will see that this wire will be raised to redness throughout its entire length. [The electric current was then passed through the wire]. The platinum wire is now red hot, and the index goes up in this prompt way. You will see the glow of the red hot wire now the light is lowered. Now, if I shorten the length of wire less and less resistance is thrown in the way of the current, and a greater amount of electricity passes through, and you have the wire raised to this much greater temperature. There is one thing to be observed here. You must not allow yourselves to suppose that this apparent thickening of the wire on being heated is due to a real thickening. The red hot wire looks as thick as a quill. This appearance, which I have no doubt is visible to you, is not due to a real thickening. It is an effect produced by a bright light on the eye. A bright body is always seen larger than it ought to be, and this particular wire now before you is seen thicker by those in more distant parts of the theatre than it is by those near at hand. This proves that it is a deception of the eye—a kind of illusion called "irradiation." It is not a real thickening. [The platinum wire was still further shortened and then parted asunder]. There, the wire is now fused by this electric current.

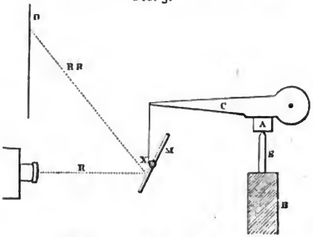
Fig. 2.



Now, I will call back your attention to this spiral C which you see here. Here on one of these supports A B is a piece of brass *p*, and here is another *p'*; and stretching across from support to support are two bars, one of brass and one of iron. At present they are not long enough to span the distance from one support to the other; but I will heat them, and then they will expand, and you will find that when they expand sufficiently to bridge this chasm from one support to another an electric current will pass, and then that spiral C will be like a voice telling us that the bars have expanded from one support to the other. We will now light the jets of gas underneath these bars, which at present are too short to span the distance between the supports. [After an interval]—Observe now that what I predicted a moment ago has occured. The spiral is now ignited. If I remove this brass bar the spiral sinks. What I want to show you by this experiment is that the brass expands more than the iron. It was the expansion of the brass which bridged the chasm across.

I have told you that a great portion of experimental science is taken up by devices of this kind to render these small expansions evident. I think there is before you on the floor in front of the table a piece of apparatus more delicate than any that has ever yet been made. It is an apparatus intended to show, among other things, the expansion of volume by heat. You will understand this apparatus immediately by reference to this small sketch that I have drawn upon the black board. I have taken simply the essential parts of the apparatus, and you will understand them, I am sure, perfectly well.

Fig. 3.



The bottom part B of the sketch represents the upper end of that upright bar of metal which you see between those two brass pillars in the apparatus in the middle of the room. On the top of this bar rests a little brass stem S; and the top of that stem is pointed and presses upon a very hard flat stone—a plate of agate A. Now, conceive the top of this bar to be lifted, and to push this stem up against the plate of agate. What will occur? You see the arm C above the piece of agate. That arm moves upon a pivot which you see marked by a dot; a very little pushing of this arm causes it to move through a greater space than the body which pushes it. Now, attached to this arm is a piece of the hair-spring of a watch, and that is carried round an axis X, attached to which axis is a piece of looking-glass—that is, a mirror M. Upon that mirror a beam of light R is cast. The figure at the left of the sketch I suppose to be the front part of a lamp from which the light will issue. The beam of light will fall upon that mirror, and will be reflected upwards R R, and will mark itself as a spot of light upon the screen D. Now, if you conceive the end of the bar to be lifted, and to push the arm upwards, it will cause the axis of the mirror to turn round, and cause the mirror to take another position; and when the mirror takes another position, this beam of reflected light will travel with the mirror, and will travel with twice the velocity of the mirror. Thus, in this experiment, instead of having a straw for an index, I use a beam of light. You will understand the apparatus when I make the experiment. I think, as I have said, it is the most delicate instrument of the kind that has ever yet been made. Now I will try and get the apparatus in proper order for showing the experiment. I throw a beam of light upon the mirror, and there you see it reflected and quivering on the wall. I will bring it down so as to get it on the screen. You see it is exceedingly sensitive. That constitutes our index. And now I will ask you to observe what I am going to do. I will not touch that heavy bar of lead; I will not heat it with a flame; I will simply breathe against it; and I believe that this apparatus is so exceedingly delicate that the mere breathing against this mass of lead (and it is very large) will cause the lead to expand upwards, and will bring down that spot of light from the top of the screen to the bottom. [The lecturer then breathed on the bar of lead, and the image of the beam of light gradually travelled down the screen.] The mere warmth of the breath is sufficient to produce this effect. Now I will pour upon the bar a little liquid that will chill it—make it cold; and I think you will find that as the bar cools it will contract, and that the beam of light will go back to the top of the screen. [The spot of light was successfully brought back to the upper part of the screen in the manner described.]

So much for these actions which this wonderful thing called heat produces. In our next lecture we shall endeavour to understand how this wonderful thing can be measured. We shall deal with the construction of thermometers and things of that kind, and I trust we shall get to know a great deal about them.

FOREIGN SCIENCE.

Paris, Jan. 1, 1868.

New minerals accompanying cryolite.—Fluosalts of antimony and arsenic.—Preparation of indium.—Electrical jewels.—Estimation of nicotine in tobacco.—Academy of Sciences: Capillary Action—Solar Spots—Synthesis of nevrine—Action of hypochlorous acid on essence of turpentine and camphor—Volumetric estimation of nitrogen—Gallic fermentation—Amalgamation of voltaic piles.

Among the many valuable and very interesting researches that have recently been made in organic chemistry in this portion of the scientific world, there are some interesting facts in mineral chemistry for your correspondent to mention. M. Hagemann has discovered two minerals accompanying cryolite, they have been named by him *dimetric pachnolite* and *arksutite*. The first resembles the pachnolite described by M. Knofs; it occurs in prisms or in quadrangular pyramids, cleavable in the direction of the base, of a pinkish white colour and very brilliant. Its density is from 2·74 to 2·76, and its hardness the same as cryolite. Sulphuric acid easily attacks it. The specimen analysed contained 2 per cent of silica, which M. Hagemann considers foreign to the composition of the mineral, to which he assigns the formula.

$$Al_2Fl_3+2(\tfrac{1}{3}Ca+\tfrac{1}{3}Na)Fl+2HO$$

Arksutite is granular, white, and crystalline, and, like the other mineral, very brilliant. Its density is from 3·03 to 3·17; its hardness is equal to cryolite. At a dull red heat it fuses, without loss of water. Analysis gave numbers corresponding to the formula $2(Ca,Na)Fl+Al_2Fl_3$. These two minerals occur at Arksut-Fiord in South Greenland, and are probably the result of the decomposition of cryolite.

M. Marignac has made an elaborate research upon the fluo-salts of antimony and arsenic; some of his results will be mentioned in a future letter.

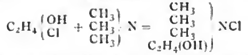
M. Richter has published a method of extracting indium from zinc: the rare element occurs in blende. The zinc is dissolved in sulphuric or hydrochloric acid, and the residue, which is composed of zinc, indium, and other metals, is treated with nitric acid. The solution is evaporated with sulphuric acid, diluted, and a current of sulphuretted hydrogen gas passed through. The indium is almost completely precipitated with the cadmium and copper. The precipitate is dissolved in hydrochloric acid, and precipitated by ammonia. By repeating the process several times the whole of the zinc and cadmium is separated. Finally, the small quantity of iron still mixed with the indium is removed by a partial precipitation with ammonia and carbonate of soda. Indium is obtained by reducing the oxide; this may be effected by heating in a current of hydrogen gas, or by the power of a voltaic battery.

A curious application of electricity has been made by a jeweller in the Rue Therèse, M. Trouvé. He makes scarf-pins, &c., with heads upon them which at the will of the wearer move their eyes. They are delighting fashionable Paris. The electro-motor is usually carried in the waist-coat pocket. It is formed of one couple, either zinc and carbon or zinc and platinum. The carbon is fixed in the vessel which holds the exciting liquid—a saturated solution of sulphate of mercury—there being an outer case in which this vessel is placed. The zinc is fixed to the lid of the case, and does not plunge into the liquid, which only fills the lower half of the vessel. So long therefore as the apparatus is in an erect position, there is no action, but when placed horizontally the current is formed. The whole apparatus makes a little case of the most trifling size. A scarf-pin with electro-motor and connections, costs from 60 francs upwards.

A process for the estimation of the nicotine contained in tobacco has been devised by M. Liecke. He exhausts the dry tobacco leaves with water acidulated with sulphuric acid, renewing the water three times, and evaporates the solution just to the consistence of an extract. This extract is treated with an equal volume of alcohol, the alcoholic solution filtered, and the residue washed with alcohol. The alcoholic solution contains all the nicotine as sulphate. The solution is evaporated, and the residue obtained from it decomposed by caustic potash in a retort heated by oil to 260° C., the nicotine being received in dilute sulphuric acid.

At the meeting of Academy of Sciences held on the 16th December, besides the memoirs, of which abstracts are given in this letter, there was a note relating to a particular effect of capillary action, from M. Definis; and from M. Kirchhoff a communication on solar spots. M. Wurtz presented a memoir entitled *Synthesis of Nevrine*,[*] this will doubtless possess great interest for scientific chemists. M. Adolph Wurtz has in fact succeeded in the synthesis of one of the proximate principles of the brain. M. Liebrich in 1865 obtained from the brain a crystallisable definite compound containing phosphorus and nitrogen, to which he gave the name of protagon. By acting upon this body with strong baryta water, phosphoglyceric acid, and a powerful base which he named nevrine, were obtained. M. Bayer has recently demonstrated that nevrine is an oxethylenic base, being in fact hydrate of oxethyl-ammonium in which three atoms of hydrogen are replaced by three groups of methyl; it is therefore hydrate of oxethyl-trimethyl-ammonium.

This fact led M. Wurtz to suppose that the synthesis of nevrine might be effected by treating hydrate of oxethyl-ammonium (formed by acting upon ammonia with oxide of ethylen) with iodide of methyl. This reaction was only partially successful, since it yielded only small quantities of the base in a state of purity. M. Wurtz succeeded, however, in performing a beautiful synthesis by another process which he has indicated for the preparation of oxethylenic bases—the treatment of monochlorhydride of glycol by ammonia. The chloride of the base nervine, *i.e.*, the chloride of oxethyl-trimethyl ammonium, is formed by the direct addition of the elements of mono-chlorhydride of glycol and trimethylamine.



$$C_2H_4\left\{\begin{matrix}OH\\Cl\end{matrix}\right. + \left.\begin{matrix}CH_3\\CH_3\\CH_3\end{matrix}\right\}N = \left.\begin{matrix}CH_3\\CH_3\\CH_3\\C_2H_4(OH)\end{matrix}\right\}NCl$$

5 grammes of trimethylamine are heated in a sealed tube, by a water bath, with 10 grammes of chlorhydride of glycol. At the end of 24 hours the tube is allowed to cool, when beautiful prismatic crystals, perfectly colourless, make their appearance. The crystals dissolve easily in boiling absolute alcohol, and they are partially deposited on cooling from concentrated solutions. Ether precipitates this solution, but if the liquid contains a trace of water, a heavy thick liquid precipitates instead. The crystals are chloride of oxethyl-trimethyl-ammonium, which is a very

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[*] M. Wurtz proposes the word nevrine as the correct translation o the German neurine.

deliquescent compound. When to a solution of this chloride a moderately concentrated solution of chloride of gold is added, a precipitate of a pure yellow colour is formed,—the double chloride. This precipitate has been shown by M. Bayer to be characteristic of nevrine. It is soluble in boiling water, the solution depositing little yellow needles. M. Wurtz has compared his aurochloride prepared from the artificial nevrine with the compound obtained from the brain substance. The crystals of the two salts under the microscope exhibit rhomboidal plates; they are identical save in the size of the crystals.

A solution of chloride of platinum added to a concentrated solution of chloride of oxethyl-trimethyl-ammonium, causes no precipitate, and no crystals are deposited upon concentration to a syrupy consistence, but addition of alcohol causes a precipitate which by analysis gives 31·8 per cent of platinum. The formula,

$$(CH_3)_3,(C_2H_4OH)N,Cl+PtCl_2$$

contains 31·8 per cent Pt.

Chloride of oxethyl-trimethyl-ammonium by the action of moist oxide of silver, is decomposed, hydrate of oxethyl-trimethyl-ammonium being set free. By evaporating the solution, a syrupy liquid is obtained, which upon heating evolves a strong odour of ammonia.

M. Wurtz thinks that the mode of formation, and the analyses he has made, leave no doubt as to the compound being really nevrine.

The eminent author of the preceding paper presented a note, by M. C. G. Wheeler, on the action of aqueous hypochlorous acid on the essence of turpentine and on camphor.

Essence of turpentine, by the action of aqueous hypochlorous acid, is converted into a yellow viscous liquid, probably a mixture of the bi- and trichlorinated compounds; at the same time another product is formed which is retained by the water. This can be completely separated by agitating the aqueous solution with ether, in which it is very soluble, and separating the etherial solution and distilling. The residue is a yellow syrupy substance, neutral, very soluble in ether and in alcohol, and slightly soluble in water. Analysis shows this compound to be $C_{10}H_{16}Cl_2O_2$. This chlorhydride cannot be distilled without decomposition, hydrochloric acid is lost in the operation. Nitric acid oxidises it, producing a resinous substance. The whole of the chlorine is removed with great difficulty, the author failed when acting upon it with sodium during several hours. He obtained in this way an acid which appeared to have the composition $C_{10}H_{16}O_3$, but the quantity was too small to admit of a decisive examination.

Camphor added little by little to hypochlorous acid is liquefied and falls to the bottom of the vessel. After a time, especially if agitated, it forms a solid mass presenting the appearance of camphor itself. By two or three crystallisations from alcohol, this product may be obtained pure. It is mono-chlorinated camphor $C_{10}H_{15}ClO$, and is formed according to the following equation:—

$$C_{10}H_{16}O+ClHO=C_{10}H_{15}ClO+H_2O.$$

Mono-chlorinated camphor is a white body, indistinctly crystalline, soluble in ether and in alcohol, and nearly insoluble in water; it crystallises much better from alcohol containing a little water, than from absolute alcohol.

It melts at 95°, and is decomposed at a temperature approaching 200°, emitting vapours of hydrochloric acid.

By treating mono-chlorinated camphor with a solution of alcoholic potash at a temperature approaching 80° during six or eight hours, the author obtained products containing no chlorine; one of them he has been able to separate with certainty, its composition is $C_{10}H_{16}O_2$. It is isomorphous with the camphinic acid of M. Berthelot. The author gives to this compound the name Oxycamphor; it crystallises in white needles, soluble in alcohol and insoluble in water; it fuses at 137°, and sublimes without decomposition, yielding fine crystals. The odour resembles that of camphor.

M. Pratt, at the meeting of the Academy on the 25th, addressed a memoir on a general method for the volumetric estimation of nitrogen in its various combinations, and on a new process for the preparation of this gas in a state of purity in laboratories. M. Van Tieghem sent a communication upon the Gallic fermentation. Your correspondent promises some account of these in a future letter. There was also a note on the amalgamation of voltaic piles by M. Demance. If M. Demance says his process is new, one might justly add, query. The process is simply the placing of metallic mercury in the cell, when, by the galvanic current, the zinc becomes amalgamated. The explanation of the manner in which this is effected, as given by him, is certainly not without interest. He has found that there is no previous conversion of the mercury into a salt, that in fact the action is nothing else than a transference of metallic mercury. Furthermore, the amalgamation only takes place under the influence of the current.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Colouring Matter of Saffron.—B. Weiss has re-examined the colouring matter of saffron (polychroite) and finds that the discrepancies in the statements of former investigators are due to the ease with which the dye decomposes during the processes of purification. The dye seems to be a glucoside; on being treated with sulphuric acid it splits up into a secondary colouring matter, named by the author crocin, sugar, and an essential oil. The composition of crocin is $C_{32}H_{18}O_{12}$, that of the oil $C_{20}H_{14}O_2$.—(*Journal pr. Chem.* ci. 65).

Cement.—Sorel describes a new cement which he prepares by mixing magnesic oxide with a more or less concentrated solution of magnesic chloride. The hardness of the cement increases with the strength of the solution; 20 to 30° Baumé is found most suitable. Its binding power is greater than that of any other cement, it being capable of producing hard blocks with more than twenty times its weight of sand or other inactive material.—(*Comptes R.* lxv. 102).

Manganese, New Compounds of.—T. Niklès Fluormanganous acid is formed by adding fluorhydric acid to an ethereal solution of manganic perchloride, or by dissolving in the concentrated acid manganic dioxide. The reactions of fluormanganous acid are similar to those of perchlorides. Alkalic fluorides produce rose-coloured precipitates of double fluorides. It likewise combines with organic bases. All these compounds are of comparatively unstable nature, most of them being gradually decomposed when in contact with much water. On adding manganic perchloride to a boiling solution of potassic or ammonic fluoride, precipitates are formed which may be considered as salts of oxyfluormanganous acid, $Mn(OFl)$.—*Comptes R.* lxv. 107).

Mimetesit, Artificial Preparation of.—By following the general method adopted by Deville and Caron for the preparation of crystallised chlorophosphates, G. Lechartier has succeeded in obtaining corresponding chlorarseniates. The arseniate and chloride of the same base are fused together, and after cooling the excess of chloride is dissolved out by water, which leaves the crystallised chlorarseniate behind. Mimetesit, $3(AsO_5, 3PbCl)PbCl$ amongst other compounds, has thus been obtained).—(*Comptes R.* lxv., 172).

Phenolsulphuric Acid, Salts of.—E. Menzner. Phenolsulphuric acid was prepared by heating equal equivalents of phenyl and sulphuric acid on the water-bath, diluting, 24 hours later, with water, neutralising with plumbic carbonate, decomposing the lead-salt with sulphuretted hydrogen, and concentrating the dilute solution first by applying heat and finally in the dessicator over sulphuric acid. The salts are obtained by neutralising the free acid with oxides or carbonates. They are all soluble in water, mostly well crystallised, contain, with the exception of the ammonic salt, water of crystallisation, which they lose at 140° C. The plumbic and cupric salts decompose when heated to that temperature. The stability of the acid, which in aqueous solution bears continued boiling, and that of its salts, support the supposition that its constitution is different from that of the normal sulphovinic acids.—(*Ann. Chem. Pharm.* cxliii. 175).

Chlorsalylic Acid, Preparation of.—Glutz. Gaultheria-oil and phosphoric perchloride in the equivalent proportion of 1 to 2 are mixed together in a large well-cooled flask. The reaction, at first very violent, is completed by heating on the water bath for several hours. The flask is then connected with a reversed Liebig's condenser, and the boiling continued for a day. After this treatment the (now liquid) products of the reaction are distilled, and the fraction going over above 220° C., poured into a large quantity of boiling water. This dissolves, under evolution of chlorhydric acid, all, except chlorsalylic trichloride, which remains as a heavy brown oil (a solid cake when cold) at the bottom of the vessel. On cooling the chlorsalylic acid crystallises out from the aqueous solution in white needles.—(*Ann. Chem. Pharm.* cxlii. 194).

Cyanacetic Acid.—Th. Meves. Pure cyanacetic acid was prepared in the following manner:—250 grm. of monochloracetic ethide, 300 grm. of potassic cyanide, and 1,200 grm. of water were heated on the oil bath in a retort connected with a reversed Liebig's condenser until the smell of prussic acid had disappeared; an excess of the ether was then distilled off. The dark brown liquid thus obtained was then neutralised, evaporated to half its original volume and filtered, the filtrate further concentrated, and after addition of an excess of sulphuric acid, extracted with ether. The etherial solution on evaporation leaves the crude acid, which is purified by being converted into the lead salt, and the latter decomposed by sulphuretted hydrogen. The salts of this acid, of which the potassic, baric, zincic, cupric, argentic, mercuric, and plumbic, are described, are very soluble in water, with the exception of the two last named. They are obtained either by saturating the free acid with the oxides or by mutual decomposition of ammonic cyanacetate with the the neutral metallic salt of the desired radical. (*Ann. Chem. Pharm.* cxviii. 201).

Toluol, Substitution Compounds of.—F. Beilstein and A. Kuhlberg. Of the four possible isomeric trichlortoluols, $\text{Ȼ}H_2Cl_3(\text{Ȼ}H_3)$, $C_6H_5(\text{Ȼ}Cl_3)$, $\text{Ȼ}_6H_3Cl_2(\text{Ȼ}H_2Cl)$, and $C_6H_4Cl\ (\text{Ȼ}HCl_2)$, the first (trichlortoluol) and second (benzoterchloride) are already known. The third, dichlorbenzylic chloride, is formed by passing a current of chlorine through benzylic chloride containing iodine, or through boiling dichlortoluol. It boils at 241°C., loses *one* atom of chlorine on being treated with alcoholic potassic hydrate. The fourth, chlorbenzylalic chloride, is obtained by passing chlorine through benzylalic chloride (chloride of oil of bitter almonds) charged with iodine, or through boiling chlortoluol. It boils at about 221°, and contains only *one* atom of chlorine firmly attached. The boiling points of the 4 isomers are respectively—235°, 241°, 221°, 218°. Benzylalic chloride dissolves in concentrated nitric acid with formation of a nitro compound, which on being treated with chromic acid is converted into *nitro-benzoic* acid, while the analogous chlor-benzylalic chloride under similar conditions forms *para* chlorbenzoic acid).—*Zeitschr. Ch*, N. F. iii. 513).

Phenylic Acid, and Derivatives of.—Glutz. Phenylic chloride is obtained by heating together in equivalent proportions carbolic acid and phosphoric pentachloride. The phenylic chloride is distilled off and freed from phenol by shaking the mixture with a solution of sodic hydrate. The residue, after distillation, consists chiefly of neutral phenylic phosphate. The boiling-point of the chloride after purification is 130° C. When heated with an excess of sulphuric acid to 100° for several hours, chlorphenyl sulphuric acid is formed, which is purified by being converted into lead salt, and separated again from the metal by means of sulphuretted hydrogen. It is a syrupy liquid which slowly crystallises under the dessicator. It is moderately soluble in alcohol, insoluble in ether. The composition of the lead salt, which crystallises well, as do most salts of this acid, is

$$\left(C_{12}\left\{\begin{matrix}H_4\\Cl\end{matrix}\right.\right)[S_2O_4]O.PbO$$

Chlorphenylsulphuric acid is converted into phenylsulphuric acid by the action of sodium-amalgam. The lead salt, treated with strong nitric acid, is partly converted into nitrochlorphenylsulphate, partly into nitrochlorphenyl,

$$C_{12}\left\{\begin{matrix}H_4\\Cl\\NO_4\end{matrix}\right.$$

The latter may also be obtained from phenylic chloride.

Phenylic phosphate $(C_{12}H_5O)_3\ PO_5$ is insoluble in water, readily soluble in alcohol, ether, and hot sulphuric acid; it is converted into diphenolphosphoric acid when acted upon by strong bases. When heated with bromine in sealed tubes to 180° the neutral ether gives rise to the formation of a white crystalline body of the composition $(C_{12}(H_4Br)O)_3.PO_5$, the reaction being represented by the following equation,

$$(C_{12}H_5O)_3.PO_5+6Br=\left(C_{12}\left\{\begin{matrix}H_4\\Br\end{matrix}\right\}O\right)_3.PO_5+3HBr$$

Ann. Chem. Pharm. cxliii. 181.)

CORRESPONDENCE.

CRYSTALLISATIONS PRODUCED BY THE BLOWPIPE.

To the Editor of the Chemical News.

Sir,—With reference to the miscellaneous memorandum under the above head in your journal of the 27th Dec., 1867, in which it is stated that the sudden opacity of beads, of borax, P. salt, or soda, is found by M. G. Rose to be due to crystallisation of contained substances, allow me to state that the fact has been long known, and is to be found in the works of Berzelius, Plattner, and other reliable writers on the blowpipe. Berzelius says (page 64):—"Titanic acid combines with soda with effervescence, and forms a clear dark green glass. This glass has the property of crystallising exactly at the moment that it ceases to be ignited. . . . This property is common to all bodies which crystallise at a very high temperature, as, for instance, phosphate of lead." Again, of apatite, Berzelius says (page 214):—"It is dissolved in large quantity by the salt of phosphorus to a transparent glass, which, when nearly saturated, becomes opaque on cooling, and acquires a crystalline appearance, less distinct, however, than that of phosphate of lead."

Plattner alludes to the same fact in more than one place.—I am, &c.,

W. A. Ross.

Woolwich, Dec. 28, 1867.

SUPPLEMENT
TO
THE CHEMICAL NEWS.
Vol. XVII. No. 422.

NITROGLYCERINE OR GLONOINE.

The awful accident which lately took place at Newcastle-on-Tyne, caused by the sudden explosion of nitroglycerine, or Nobel's patent blasting oil, has induced me to collect together, from various sources, chiefly published abroad, the following particulars in respect of this substance, and as many of the leading daily London papers have in various ways given accounts about nitroglycerine which are incorrect, I venture to hope this paper will not be found by yourself, Mr. Editor, and your many readers quite uncalled for.

Nitroglycerine was discovered by the well-known Dr. Sobrero, now Professor of the Technical Institute at Turin, somewhere about 20 years ago. The substance was studied simply in a scientific interest by Dr. J. E. de Vrij, the chemist of the Netherlands Indian Government, well-known for the analysis of this and testing of the Cinchona bark, and also by Dr. Gladstone, and of late by Dr. Kopp. Up to the end of 1864 nitroglycerine was not only not familiarly known, nor to be had in quantity in commerce, but continued to belong entirely to the domain of science. This may easily be accounted for by the fact that glycerine itself is only in use and to be had on the large scale since the last 8 or 10 years. When pure, nitroglycerine is a liquid of from 1·525 to 1·6 specific gravity; it has no odour, is often colourless, or yellowish, has a sweet, pungent, aromatic taste, and is powerfully poisonous. It is only very slightly soluble in water, readily so in ether, alcohol, and methylated spirits; it does not inflame when touched with a light, nor does it explode by being so touched, but concussion, touching with a red-hot iron, or the concussion due to the explosion of gunpowder, and, better yet, detonating mixtures, and fulminates, sets off the nitroglycerine. According to Dr. Johann Rudolf Wagner, the well-known technologist to the Bavarian Government, nitroglycerine may be cooled down to 4° Fahr. without becoming solid; but it appears after all that the nitroglycerine of commerce, if exposed for a continued period to 46·4° Fahr., becomes solid, crystallising in long needles, which are most dangerous to handle, since they explode, even on being gently broken, with a frightful violence. At 320° Fahr. the nitroglycerine begins to decompose, giving off red vapours, and if the heat be suddenly applied, or slightly raised above this point, the substance explodes instantaneously, and with great violence, shattering even open vessels to atoms. Nitroglycerine may be assumed to consist of anhydrous glycerine, in which 3 atoms of hydrogen have been replaced by 3 atoms of NO_4. The products of the complete combustion of 100 parts of pure nitroglycerine are the following:—

Water	20
Carbonic acid	58
Oxygen	3·5
Nitrogen	18·5
	100·0

Since the specific gravity of nitroglycerine is 1·6, one volume, say 1 cubic inch of the material, yields on combustion or explosion—

Aqueous vapour	554	volumes, or bulk.
Carbonic acid	469	,,
Oxygen	39	,,
Nitrogen	236	,,
	1298	,,

According to Nobel, these gases expand on explosion to 8 times their bulk. 1 cubic measure volume of nitroglycerine will, therefore, give 10,384 cubic measures of gases; while 1 cubic measure of gunpowder will only yield 800 cubic measures of gases. Hence it follows that for equal bulks nitroglycerine is 13 times stronger than gunpowder, while by equal weights the former is 8 times stronger than the latter.

The danger of the use of nitroglycerine is greatly enhanced by the instability of this compound; even when pure it is affected by increase of temperature, and at from 68° to 75° Fahr. it is prone to incipient spontaneous decomposition, accompanied by a slow but sufficiently strong escape of gaseous compounds, which, while exerting a slight pressure on the vessels the liquid is contained in, also can cause the fluid to explode on the slightest concussion. During the slow and spontaneous decomposition of the glonoine there are formed divers products, among these glyceric, oxalic and hydrocyanic acids, and ammonia, and others unknown. Nobel's patent nitroglycerine, or blasting oil, is made in the following manner:—To 13·5 parts by weight of strong sulphuric acid is added 1 part by weight of nitrate of potash of best quality, and this mixture cooled down to 32° Fahr., the result of which is the crystallising out of a salt which contains 1 equivalent of potash, 4 equivalents of sulphuric acid, and 6 equivalents of water; the strongly acid liquid is decanted from the crystals, and to the liquid, commercial glycerine is added, taking care to keep the liquid cold; the ensuing nitroglycerine is separated from the acid by water, once washed with fresh water, and is fit and ready for use.

I may here observe that the manufacture of the substance which has already given rise to so much mischief, is carried on in the free City of Hamburgh, which is not subject to any of the laws which in other closely adjacent countries would render the manufacture of the nitroglycerine, if not entirely illegal, at least subject to very stringent but equally justifiable police supervision. In France, Switzerland, Belgium, and the Netherlands, where the French law of 1810, *régulant les métiers insalubres et dangereux* is yet in force, the manufacture of this article can be prohibited. The best mode of manufacturing nitroglycerine where it is desirable to use it, and that is the case in open quarries where one has to deal with tough hard rock, is to make it extempore on the spot where it is to be applied. Take a sufficient quantity of strong nitric acid, density from 1·4758 to 1·4902, mix therewith the double of its weight of strong sulphuric acid, weigh off 3300 grammes of the acid mixture when quite cool; take 500 grammes of glycerine, which must be free from either lime or lead salts, and mix the same cautiously with the acid while keeping the mixture very cool by constantly stirring. Let the mixture stand quietly for about 10 minutes, and then pour it out in from 5 to 6 times its bulk of cold water, taking care well to stir the same all the while. The nitroglycerine will sink to the bottom; the dilute acid is removed by decantation, the nitroglycerine once more washed with water, when it would be fit for use after removal of the latter. The glycerine to be used should have a specific gravity of from 1·2459 to 1·2562 *i.e.*, contains from 94 to 96 per cent real glycerine. Dr. Gladstone has found while engaged with his researches on nitroglycerine, that the perfectly anhydrous glycerine did *not* yield, when treated with the mixture of nitric and sulphuric acids, an explosive compound, but, on the contrary, one which when touched with a flame, or red hot metal, burns off pretty quietly. Impure nitroglycerine is dangerously self-explosive, even while standing quietly.

From the evidence brought forward at the coroner's inquest at Newcastle-upon-Tyne, it appears that the nitroglycerine which had been brought to that town certainly contained some methyl-alcohol, or methylated spirits of wine, not in sufficient quantity to render the nitroglycerine safe; in fact it is not in the interest of the makers of the article to render it so, as this would evidently occasion the trouble of having to separate the nitroglycerine from its solution by the addition of water, previous to being fit for use, and this trouble would be undoubtedly disliked at the mines and quarries, and the use of the article therefore discarded.

From the evidence, given at the inquest just alluded to by I. L. Bell, Esq., the well-known proprietor of large chemical works, collieries, and iron mines, in the county of Durham, it appears that the printed instructions issued by M. Nobel, of Hamburgh, the manufacturer of the nitroglycerine, contain statements which are very contrary to fact, and apt to mislead, and hence give rise to serious mischief and grave danger, while the instructions omit to mention how to deal safely with the article when congealed. The quantity of nitroglycerine, 30 canisters, originally brought to Newcastle in May last, and stored in a public-house under the semblance of dirty grease, was equal to 4·5 tons of powder, and would, according to the pamphlet of M. Nobel, have sufficed to blow down 115,000 tons of solid rock. Mr. Bell stated that he had caused the use of nitroglycerine to be discarded in his mines on account of the injury to the health of the workmen. The inducement to the use of this substance is that, as compared with gunpowder, its effect in blasting is far greater, with less previous labour, and that its use loosens large blocks of rock or stone without crumbling, thus enabling miners and quarrymen to extract large masses of stone easily and without damage. The Messrs. Webb and Co., of Carnarvon, Wales, are the sole agents and consignees of Nobel's patent blasting oil in this country. They also have on hand an article made by Nobel, and sold under the name of dynamite, or patent safety blasting powder, 7 times stronger than ordinary gunpowder. It is stated that dynamite will not explode either from a spark or concussion alone, but requires the combined effect of both. In a compressed state it may be fired under water equally well as nitroglycerine. What that dynamite is made or composed of I have not been able to find out; I never saw a sample of it, nor find it mentioned otherwise than in advertisements.

A. Adriani.

Mr. Nobel has written to defend his blasting oil against many of the accidents which have been laid to its charge, he also denies that it possesses some of the properties that have been ascribed to it.

The following almost ludicrous examples, tending to show that the accidents have chiefly arisen from ignorance, are detailed with several others in a list of minor disasters which have resulted from its use:—

"In five cases congealed nitroglycerine has been melted purposely over fire.

"In three cases a red-hot poker has been inserted into the oil in order to melt it.

"In one case a man took to greasing the wheels of his waggon with nitroglycerine, knowing what it was, and it went all right until it struck hard against something, and the wheels went to pieces.

"In one case it was burnt in a lamp as an improvement on petroleum.

"In these days every mischief is charged to nitro-glycerine. Thus, we read in the *Northern Evening Express* that recently a box with nitro-glycerine exploded at a railway station in the city of Berlin, 'and that the simple act of placing it in the van caused it to explode.' It is a proved and confirmed fact that it was fulminate of mercury that exploded."

Nitro-glycerene, Mr. Nobel says, has been accused of spontaneous combustion, but the truth is that unless properly purified, it emits a nitrous odour and will gradually decompose during some years. The nitro-glycerine, however, now made by him is always pure, he writes "chemically pure"; it is obtained by crystallisation from wood naphtha.

"Nitro-glycerine is also charged, and all the world believes it, with being extremely dangerous, even from the scratch of a needle, when congealed. It is a mere fable. It is the nature of every explosive to be more sensible to concussion in its liquid than solid state, since bodies, as a rule, are possessed of greater stability at a lower temperature. As regards nitro-glycerine, the congealed crystals, to be exploded, require a far more potent blow than the liquid oil, and it was probably owing to adhering drops of the latter that the Newcastle explosion took place. A crystal thrown with great violence against a stone or iron plate is crushed without exploding, and a strong percussion cap, when inserted into it, produces the same effect. In the mines of Kœnigsgrube (Silesia) a large lump of congealed oil was hurled by an explosion against the rock, and dropped harmlessly to the ground."

Another accusation cited, and refuted, is that of nitro-glycerine exploding by contact with oil of turpentine. Mr. Nobel maintains that nitro-glycerine is a substance of uniform composition and very reliable.

There is unquestionably much truth in many of the remarks made in this letter and we thoroughly acquiesce in the following statement.

"Whenever an article can be regularly manufactured it may be regularly used, and accidents are only the result of inexperience—the want or neglect of instruction."

NOTICES OF BOOKS.

First Principles of Modern Chemistry. A Manual of Inorganic Chemistry for Students and for use in Science Classes. By U. J. Kay Shuttleworth. London: John Churchill and Sons. 1867. (Pp. v. and 214).

This little book is mainly founded on Dr. Williamson's lectures at University College in the session 1864-5, and on those delivered by Dr. Frankland at the Royal College of Chemistry in the following winter. It was originally intended to supply the want of a strictly elementary manual for the use of science classes—a want, however, which, in our opinion, has had no real existence since the appearance of Professor Roscoe's excellent "Lessons in Elementary Chemistry." The great and rapidly-increasing popularity attained by Dr. Roscoe's book is no less an indication of the reality of the want of a manual of this character, than a measure of the success with which that want has been met. Already the book has been translated and avourably received in Germany, and we understand that Professor Beilstein is about to prepare a Russian edition for the use of his students at St. Petersburg. Without laying claim to any great degree of originality, the author of the book before us has attempted to indicate how the study of the non-metallic elements may be facilitated by the aid of modern theories, and thus the student's early steps rendered less tedious and more suggestive than they commonly are. Dr. Frankland's system of notation is employed throughout the work, together with Dr. Crum Brown's method of graphic formulæ; the author considering that the advantages of the former ought to insure its universal adoption, whilst what is sometimes urged as a fundamental objection against the use of the latter, namely, that students are prone to regard graphic formulæ as physical arrangements of the atoms, he believes not to be warranted by the experience of those who have given the method an impartial trial.

No detailed directions for manipulation are given, the author justly considering that such directions are seldom very intelligible, except when given orally in presence of the objects used. Practical study in a laboratory should invariably accompany a course of reading in chemistry although the manifest advantages of such method of study have hitherto, in the system of cram so much in vogue, been too frequently lost sight of. In the few instances in which they have been attempted the detailed descriptions of apparatus are fairly given. The author, however, has erred with other compilers of chemical manuals, when describing the method of determining the composition of water by volume (p. 83) in ascribing the invention of the pear-shaped vessel with its elaborate system of screws, glass stoppers, brass and glass stopcocks, &c., to Cavendish. True the apparatus here referred to is the one selected by the Cavendish Society as their emblem, and appears on the title pages of its publications, but withal Cavendish never employed such an instrument.

The apparatus, as described by him in his memoir in the *Philosophical Transactions* consisted simply of a glass globe provided with a stopcock, wires for the passage of the spark, and an arrangement for suspending it to the beam of the balance. The eudiometer figured in tho pages of its publications (and in Mr. Shuttleworth's book) represents the instrument as constructed at the period of the formation of the Society, and not as it was actually employed by Cavendish.

Before entering on the more special part of the subject two chapters are devoted to a consideration of such of the principles of physics as may be deemed indispensably necessary to the student. The author believes these chapters to contain nearly all the knowledge of heat required by the University of London for its matriculation examination, and moreover the subject is treated very much in the order laid down in the University Calendar. In the description of the different thermometric scales in use, the commonly-received opinion is that Fahrenheit fixed his zero-point at the temperature of a mixture of snow and salt or sal-ammoniac, on the supposition that in such a mixture no heat remained. It is, however, the opinion of at least one well-known Professor of Natural Philosophy (moreover a London University Examiner) that Fahrenheit had other and far more philosophical reasons for thus defining his zero, but what those were it is impossible at this distance of time to determine, since the Dutch physicist left scarcely any papers at his death.

The study of the laws regulating chemical affinity is deferred until the student has gained a preliminary knowledge of the principal facts concerning hydrogen, chlorine, and their compound hydrochloric acid. This method of procedure has unquestionably the merit of simplicity over the more usual plan, and materially facilitates the subsequent consideration of the laws of combining proportions, atomic volumes, &c.

Considerable space is justly afforded to a consideration of the properties of water, and their influence in the economy of nature; of the peculiarities of the several kinds of natural waters, together with the methods for their purification from natural impurities and artificial contaminations. The author very properly insists upon the injurious effect of allowing the gases, which enter through the waste-pipes descending into drains and sewers, to pollute the water in our cisterns. "The arrangement to which this abominable nuisance is due is briefly this; cisterns are filled daily by means of a tap, to which is fitted a ball-cock to arrest the supply of water so soon as the cistern is nearly full; just above the level where the rise of water in the cistern is thus arrested is the opening of a pipe which leads straight into a drain communicating with the sewer; lest the atmosphere of the house should, through this pipe, be placed in direct continuity with that of the drain and sewer, it is usual to make the pipe that enters the drain curved at its lower end, in the shape of the letter J; it is imagined that this bent extremity of the tube will always be kept filled by water flowing down from the waste-pipes, and will act as a tolerably effectual valve so as to exclude the sewer gases. But what is really the fact? On account of the very ingenious regulation of the ball-cock, no water can ever pass into the waste-pipe at all, nor even rise to the level of its orifice; the consequence is that if there ever was any water in the bend of the waste-pipe it cannot have remained there long, nor can it ever be renewed; hence no valve is interposed between the atmosphere of the house and that of the drain, and fires, and chimneys—creating the draught which enters the house at every chink and opening—suck into it the foul gases of the drain and sewers to pollute the air we breathe, and not only so, but also—seeing that it is across the surface of our cisterns that all these gases (many of them highly soluble in water) are dragged—to render the water which we drink, and which we associate with the idea of purity and cleanliness, unclean and deleterious. The only cure practically applicable and fairly reliable for water thus clumsily contaminated, after it has, perhaps, for the sake of a pure supply, been brought from a great distance and filtered with extraordinary care, is filtration through animal charcoal, renewed regularly at short intervals. But since prevention is better than cure, and (so far as I know) the only *sure* way of avoiding these dangers of contamination in towns is to allow water to be drawn straight from the mains, without the intervention of any apparatus of cisterns and waste-pipes, and to have a constant instead of an intermittent system of delivery, this plan, already followed in Manchester and some other towns, and at the public drinking fountains in London, should be universally adopted." (pp. 98—99).

A large portion of the chapter on the atmosphere is avowedly compiled from Dr. Roscoe's article in "Watts's Dictionary of Chemistry," but the author errs in ascribing the gravimetric process for the determination of the principal constituents of the air to Dumas and Peligot. Dumas's collaborateur in the famous research was, as every tyro could tell, not Peligot but Boussingault. On p. 123 we see repeated the statement of Liebig that the absolute quantity of carbon contained in the atmosphere as carbonic acid amounts to more than the weight of all the plants, and of all the strata of mineral and brown coal existing on the earth. A moment's calculation will suffice to show the incorrectness of this statement. The relative volume of carbonic acid contained in the atmosphere is usually stated at four volumes in 10,000 of air, equivalent to ·0612 per cent by weight. It certainly cannot exceed this amount, indeed the recent researches of Angus Smith on the air of mountains, and of Thorpe on sea-air, render it highly probable that this number as an average is somewhat too high. From the barometric pressure of 30 inches of mercury, and the known area of the globe, the weight of the atmosphere is found approximately to be 5,260,000,000,000,000 tons, and hence the weight of carbonic acid would be 3,220,000,000,000 tons. Now Mr. Hull, in his "Coal-fields of Great Britain," estimates the amount of available coal in the English and Welsh coal fields at 60,000,000 tons for 1000 years, and states the American coal fields to be 72 times greater than our own. Assuming it to contain 80 per cent of carbon, this coal by its combustion would produce 12,845,000,000,000 tons of carbonic acid—a quantity nearly four times as much as that actually existing in the atmosphere at present. Bischof has also demonstrated the falsity of this statement of Liebig, by calculating the probable amount of carbon contained simply in the thick strata, occurring both in the clay slate and in the more recent schistose formations. Assuming the average quantity of carbon contained in these strata to be 0·1 per cent—a quantity without doubt far short of the actual amount—and assuming also the thickness of the entire sedimentary formation to be eight miles, it may easily be shown from these data that the carbon contained in these strata would amount to nearly seven times as much as the absolute weight of carbon in the atmosphere.

But enough has been written to show the general character of this book. On the whole, it fairly represents such of the leading features of the science as may be gleaned from the study of the non-metallic elements. We cannot, however, anticipate for it a permanent place among established manuals. The book is doubtless adapted to the requirements of students preparing for the matriculation examination of the University of London, and intending to proceed to an Arts degree, although we are slow to believe that this constitutes the main idea of the author, since any book, however ably compiled and arranged, professing merely to facilitate the process of cramming, is unworthy of much respect or toleration.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Bulletin de la Société Chimique de Paris.
August.

Baissa, "A new Method of Manufacturing Soda." Schippman, "A Method of Manufacturing Hyposulphite of Soda from the Waste Products of Soda Making." Clamandot, "A new Silica Glaze for Pottery Ware." J. Fuchs, "On Preparing Metals in Fine Powder by Amalgamation." Evrard, "On the Manufacture of Aluminium Bronze." W. Fuller, "A Method of Separating Gold and Silver from their Ores by means of Lead." Esquiron and Gonin, "On a Method of Revivifying Peroxide of Manganese." Tilghman, "A Process for Manufacturing Paper Pulp from Wood." J. Rousseau, "An Improvement in the Manufacture of Beetroot Sugar." Junemann, Du Rieux, and Bottger, "On the Use of Strontia in the Manufacture of Sugar." Du Rieux and Bottger, "A new Method of Treating Beetroot Pulp and Juice with Lime." Bouane, "A Method of Deodorising Vulcanised India Rubber." Fortier, "On a Process for rendering Fabrics Waterproof."

Annales de Chimie et de Physique.
August, 1867.

A. Cornu, "Researches on Crystalline Reflection." P. Vigier "On the Mteallic Phosphides." W. D. Khanikof and V. Louguinina, "Some experimental Researches on Henry and Dalton's Theory of the Absorption of Gases by Liquids at a Constant Temperature and under variable Pressures." J. Boussingault, "On the Fermentation of Stone Fruits." V. Longuinine, "On the Density and Dilatation of Benzene, Toluene, Xylene, and Cymene." Parret, "Note on the Use of Pyrites instead of Sulphur in the Manufacture of Sulphuric Acid."

Bulletin de la Société Industrielle de Mulhouse.
July, 1867.

M. Ziegler, "On the Presence of Aniline in the Coloured Fluid ejected by the Sea Hare *Aplysia depilans*." G. Schaeffer, "Report on Pernod's New Extract of Garancine. Jundt, "Report on Broun's Photographic Reproductions of Sketches and Cartoons." Scheurer-Kestner, "Report on A. Rivière's Memoir on the Preparation of Caustic Baryta." J. Schlumberger, "On a Peculiar Product of the Calcination of Paper." Scheurer-Kestner, "On the Presence of Chloride of Calcium in certain Fossils found in the *Lehm* near Colmar." A. Braun, "On some Carbon Prints." E. Hofer-Grosjean, "On the Substitution of Cadmium for Bismuth in Stereotype Metal." A. Braun, "On an Improvement in the Carbon Process."

NOTES AND QUERIES.

Deodorising Petroleum—I have been informed that a solution of "plumbate of soda" will deodorise petroleum. Can any of your correspondents courteously give me instructions in the mode of preparing and using this agent.—O. P. A.

Cleansing Fire-arms.—Can any of your readers kindly inform me as to the composition of the "spirit" sold for cleansing fire-arms. I imagine turpentine is one of the principal ingredients.—Thomas Blair.

Water for Steam Boilers.—E. S. T., in "Notes and Queries," will find all he requires in "Engineering," (published at 37, Bedford Street, Covent Garden), for March 22nd, 1867, page 280; for March 29th, 1867, page 304; and May 10th, 1867, page 484.—H. K. B.

Extraction of Oil—Dyeing Turkey Red.—In answer to correspondent E., I can state that bisulphide of carbon is inapplicable to the extraction of olive oil from an aqueous solution of carbonate of potash, as bisulphide of carbon is decomposed in alkaline solutions forming sulpho-carbonate of the alkali, which still keeps the oil in solution. The process carried out in Turkey-red works for the recovery of oil is to neutralise the emulsion with sulphuric acid, when the oil separates. Hyposulphite of alumina has been tried as a mordant in Turkey-red dyeing, but does not produce colours so brilliant as the mordants in use. To describe the Turkey-red process, as carried on in Lancashire, would occupy more than the space set apart for "Notes and Queries;" but I may state here that the Turkey-red dyers of England are three in number. Two of them adopt a process similar to that invented and carried on by F. Steiner, Esq., of Accrington, who is the third. This method cannot be applied to the dyeing of yarns. The process for yarn dyeing is a modification of the Scotch process for cloth.—F. F. F.

MEETINGS FOR THE WEEK

Saturday.—Royal Institution, 3 o'clock, Professor Tyndall on "Heat and Cold." (Juvenile lectures.)
Monday—Medical, 8 p.m.
Tuesday—Royal Institution, 3 o'clock, Professor Tyndall on "Heat and Cold." (Juvenile lectures.)
Wednesday—Geological, 8 p.m. On the "Lower Lias of Bristol," by W. W. Stoddart, Esq., F.G.S. On the "Lower Lias at Cotham, Bedminster, and Bristol," by C. O. Groom Napier, Esq., F.G.S.
— Microscopical, 8 p.m.
Thursday.—Royal, 8½ p.m.
— Zoological, 8½ p.m.
— Royal Society Club, 6 p.m.
Friday.—Astronomical, 8 p.m.
— Geologists' Association. Anniversary meeting, 7½ p.m.

TO CORRESPONDENTS.

W.—1. The oil-nut has been submitted to a high botanical authority for report upon. 2. We believe no one bought the business you speak of. You can get everything you require in the way of apparatus at Griffin and Sons, Garrick Street.

W. R.—Will our correspondent favour us with the full description of the dyeing process which he thinks would be too long for our columns?

X.—The explanation is very simple. Each acid will separate a portion of the other from its combinations. Our Publisher says that he can supply the periodicals if you will send particulars.

W. H. Vodrey.—We are obliged for our correspondent's calling attention to the article, and will endeavour to meet his wishes. It is very gratifying to find that the American reprint of the Chemical News is so highly appreciated in all parts of the United States.

J. W. Young.—Received with thanks.

D. Waldie.—The remarks referred to in the Quarterly Journal were not written by the Editor, and were in fact inserted without his knowledge. We will draw attention to your answer.

C. P. Bahin.—Either Bowditch's or Sugg's treatise on coal gas will answer your purpose. They have each been reviewed in these columns.

Spectrum will find some excellent articles on the application of spectrum analysis to the microscope, by Mr. Sorby, in recent volumes of the Chemical News.

Enquirer.—The French metre is the forty-millionth part of the length of the earth's meridian, or the ten-millionth part of the distance from the equator to the pole.

A Mystery.—A correspondent forwards the following cutting from a contemporary, and asks for an explanation: "Luccinic Acid.—M. J. Hooper, in a communication to the Chemical News, points out that the presence of active acid or a soluble acitate, partially or entirely suspends the ordinary reaction of succinic acid in solutions of ferric salts."

H. Bamber—Coat the polished steel with a mixture of lime and sweet oil before putting it away. This will prevent it getting rusty.

Analyst.—A mixture of finely granulated zinc and iron filings, put into an alkaline solution of a nitrate, will cause all the nitrogen to be evolved in the form of ammonia. Harcourt's process for estimating nitrates is based on this principle.

Xpect.—You can filter the strong nitric acid solution through a tuft of gun cotton loosely pushed into the neck of a funnel.

E. K. B.—We strongly advise you not to attempt to prepare chloride of nitrogen. Nitroglycerine is innocence itself in comparison to it.

Communications have been received from Dr. H. Bence Jones, F.R.S.; M. Peterson; J. Hallett (with enclosure); Constantine, Count Zabielo; L. Lloyd; F. O. Ward; Dr. Quarlach; F. H. Hill (with enclosure); Dr. Rohrig (with enclosure); J. Russell; W. Holyoak; F. Roberts; Dr. Letheby (with enclosure); A. Lavenant; Dr. R. Angus Smith, F.R.S.; Captain W. A. Ross (with enclosure); T. Reader (with enclosure); F. C. Samuels; G. F. Symons; Dr. Wilhelms; C. P. Bahin; E. J. Quarles; W. Sutton (with enclosure); T. Blair; D. Waldie (with enclosure); J. Wallace Young (with enclosure); S. Smith; Vodrey and Bro.; J. Bray; M. A. Whichelo; W. Rodger (with enclosure); W. H. Dear W. Salter (with enclosure); J. E. Thorpe; W. E. Walker; P. Jessop; G. Farrer; L. Honer; W. Wilson (with enclosure); W. Kelso; W. H. Hoadley (with enclosure); J. H. Johnson (with enclosure); Longmans and Co.; Spottiswoode and Co.; E. W. Eccles; J. Robarts Penrose; Dr. Adriani; A. C. Bowdler; Dr. Day; Mawson and Swan; H. Rastrick; J. Chalmers, A. Glendinning; J. A. Parkes; L. Wundt; C. E. Gorman; P. Darcey; Rev. A. Rigg; Liebig Extract Meat Company.

Books Received.—"Philosophical Magazine" for Jan., 1868; "Popular Science Review;" Hardwicke's Science Gossip;" "First Principles of Modern Chemistry," by U. J. Kay Shuttleworth, London, Churchill; "Braithwaite's Retrospect of Medicine," London, Simpkin and Co.; "American Journal of Mining;" "Scientific American;" "American Gaslight Journal;" "Pharmaceutical Journal;" "A Dictionary of Chemistry," by Henry Watts, B.A., F.R.S., part xliii., London, Longmans and Co.; "The Journal of the Quekett Microscopical Club," London, Robert Hardwicke.

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THE CHEMICAL NEWS.

Vol. XVII. No. 423.

ON

HEAT AND COLD;

A COURSE OF

SIX LECTURES*

(Adapted to a Juvenile auditory).

DELIVERED AT

THE ROYAL INSTITUTION OF GREAT BRITAIN,

(CHRISTMAS, 1867–8),

BY

JOHN TYNDALL, Esq., LL.D., F.R.S.

Lecture II.

Change of volume (continued)—The force of heat—How to measure heat—Boiling water.

I want you in the first place to pay attention to what Mr. Cottrell will do here in front of the table. There is a very thick bombshell, for which I am indebted to the great kindness of my friend Professor Abel of Woolwich. It is now filled with water, and the hole of the bomb is plugged. Mr. Cottrell will now place the bomb in this bucket, which contains a mixture of pounded ice and salt; and I want, if I can, to explode that bomb. Do not feel in the least alarmed about it. The explosion will not be such as to injure any one. I will ask him now to cover the bomb carefully with this freezing mixture of pounded ice and salt, and we will leave it there for half or three-quarters of an hour, first putting a blanket over it in order to keep the warm air of this room from acting upon it. And now on the top of this I will put these iron bottles and this leaden bottle, which also all contain water. Having placed them in the freezing mixture we will examine what occurs when the water within these bottles and this bombshell freezes. It will require, no doubt, half an hour or more to produce any action upon the bomb, because it contains a very considerable amount of water. We may possibly obtain an action more rapidly upon the iron bottles, though they are exceedingly thick. We made a similar experiment with a bombshell in the yard of the Institution, and there it occupied only half an hour to freeze the water and burst the bomb. The result is here in these fragments which are on the table. Look at the thickness of these pieces. I hope the bombshell now in the bucket will be pleasant and courteous and agreeable enough to burst before the lecture is ended, but in case it does not burst, these fragments must represent the effect I intended to produce. [At a subsequent stage of the lecture the success of the experiment was indicated by the bursting of the bomb. At the conclusion of the lecture the bottles were also found to have been burst by the freezing of the water.]

And now let me recur for a moment to our last lecture. I then attempted something very daring indeed. I dare say many of my elder hearers will have imagined that, in fact, I aimed too high,—that I endeavoured perhaps to make you understand too much; but I do not think that that was the case. I think it is possible for your minds to see the operations of this thing that we call heat almost—not quite, I think, but *almost*—as clearly as I see these operations myself, and for this reason I wish, as far as in me lies, to make you see what I see, when I think and talk of this thing that we call heat. It was for that reason that I endeavoured to cause you to picture to your minds first of all the motion of the particles produced by striking a piece of lead. You remember I put a piece of lead upon the anvil and struck it forcibly with the hammer, and in that way I produced heat. I then went on from that to what we call combustion; and I asked you to consider this combustion as something almost identical with the action of the hammer upon the lead,—that the combustion of bodies is due to the fact that our atmosphere contains what is called oxygen gas—the vital gas,—and that when certain bodies are raised in temperature this oxygen hits them with such force as to produce the effects that we call combustion. This, in point of fact, is the theory of combustion. If we remove the oxygen from a place where a body is burning, you will find at once that it can no longer burn. In order to make that evident to you, I have here a candle which I intend to place under what is called the "receiver" of an air-pump. Now you have the candle burning within the receiver of the air-pump. If I allowed it to continue burning, the oxygen enclosed in that receiver would by and by be exhausted by the burning of the candle, and the flame of the candle would die out as soon as the exhaustion of the oxygen took place. I will hasten that exhaustion by working the pump, and rendering the atmosphere around the candle rare; and you will find that presently the flame will become rather feeble. [The air-pump was then set in action.] You see the flame is already beginning to become dim. Now it is very dim. As I work on it becomes still dimmer, but if I let a little oxygen into that receiver I at once restore the brightness of the flame. [Some oxygen was caused to enter the receiver.] Now the flame is brighter than it was before. If I exhaust again you will find that as we take the oxygen away we remove the atoms that are now, as it were, showering down against the combustible matter of that candle. If we take those atoms away you see the flame becomes more and more feeble; and finally if I proceed farther I should be able, of course, to entirely extinguish the flame, for when these little oxygen atoms are no longer able to rain down upon that flame, then the flame inevitably goes out. I will readmit the air before the flame is quite extinguished. [At this moment the candle ceased to burn.] Ah! I am too late, and the flame has gone out. Now, you saw that just before that flame went out it was exceedingly feeble. It was exactly similar to the flame that you obtain at very high elevations upon the earth's surface. Many years ago Dr. Frankland and myself spent a whole night upon the top of Mont Blanc. We slept upon the top, and we there burned a number of composite candles such as we have here, and we also burned a number of them at Chamounix. The air upon the top of the mountain was very rare and very thin, and it was most wonderful to see the effect of this rarefied air upon the flames of the candles. They were exactly like the flame you saw here immediately before it went out. Strange to say, however, the quantity of stearine (the stuff of which these candles were made) consumed above in one hour was exactly equal to that consumed below. There was no sensible difference, in fact, between them, notwithstanding the enormous difference in the characters of the flames. So much for these flames.

We must now say one or two words with regard to the structure of this wonderful and beautiful thing—flame. If you look at the flame of a candle you will observe a particular portion of it to be much more luminous than the rest. At that particular part the flame gives out its greatest light; and if you light two candles, such as I have here, and look at the flame of one of these candles through the flame of the other, you will find that you can, with the greatest ease, see one through the other for a considerable distance upwards; but then you come to a very bright portion of the candle flame, and that bright portion almost wholly cuts off the vision of the other candle. Thus, through the part of the most intense brightness the light of the other candle cannot pass. There is something going on which intercepts the light of the other candle. Now, what is this something? This will lead us to a knowledge of the structure of this beautiful flame. The flame here is produced in this way. We have a wick in the centre of this column of greasy combustible matter. We ignite the wick. The heat first of all liquefies the greasy matter, and not only liquefies it, but reduces it to a state of vapour, or gas. The candle actually makes its own gas. This vapour comes from the candle straight upwards; and being heated and surrounded by the oxygen of the air, this heated vapour is immediately attacked by the oxygen; the atoms of oxygen plunge against the vapour, and what we see as light and heat is the result of this collision. But, let me say a word or two more with regard to flame. I have spoken of the vapour of the greasy matter of the candle. That vapour is composed mainly of two distinct substances. It is called a "hydrocarbon." We have there hydrogen, which is a gas, and we have carbon, which is also, under certain circumstances, a gas. These bodies are united together in the grease of this candle. Now follow me, please; and you will understand the structure of this candle-flame immediately. The vapour is attacked by oxygen; but the oxygen loves the hydrogen better than the carbon. It takes the hydrogen first, and liberates little solid particles of carbon in the flame. These carbon particles are the soot which you see sometimes in a smoky flame. You see the smoke here, in point of fact. If the combustion were perfect all that smoke would be burned, and it would be raised to a white heat in the flame. In that particular portion of the flame which gives out the maximum amount of light you have a crowd of these solid carbon particles raised to a white heat by the intense temperature of the flame. And then, finally, these carbon particles also become burned, and the products of combustion pass away into the air as gas. This is the structure of all flames—first of all, an inner core of unburned gas or vapour; and then round about that the oxygen of the air plunging, as it were, against the heated vapour, and forming a kind of luminous shell round about the interior ball.

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* Reported verbatim, by permission of the Author, for this journal.

If, when the carbon particles were heated and liberated from the hydrogen in the manner I have described, oxygen were at once to seize upon them, you could not have this intense luminosity that you find in the candle-flame. Here is a lamp, constructed by a particular friend of mine —Professor Bunsen, of Heidelburg—and you see it burns with a very small amount of light. The reason of that is that, by means of these apertures which he has made round about the central tube he mixes the oxygen of the air with the gas before the gas is ignited, and the presence of this oxygen entirely destroys the existence of these carbon particles, to which the light of the flame is mainly due. If I cut off the air the gas alone will come out, and you see then at once that the light greatly increases. In the former case you have the carbon particles halting for a moment in the flame, and raised to a white heat before the oxygen seizes them; and thus you have a far greater amount of light than when you allow the oxygen to get in amongst them and seize them the moment they are liberated.

The combustion which I have just shown you is of a very vivid kind. There are also slow kinds of combustion going on. For instance, when the oxygen of the air attacks iron, it produces that red iron rust with which you are all very well acquainted. This is just as much a case of combustion as the combustion exhibited in the candle-flame. It is a case of slow combustion. When the earlier of the Atlantic cables was made it was surrounded by iron sheathing to protect it; and it was found in one case that the temperature of a great coil of this cable became very high indeed—so high as to imperil the gutta-percha and other substances that were employed to insulate the wire. This was found to be due entirely to the slow combustion—to the rusting, or "oxidation," as it is called, because oxygen is concerned in it—of the iron. The iron was slowly burned, and the heat could not get away because the coil was so large, and the consequence was that its temperature became dangerously high. Mr. Siemens has invented an exceedingly beautiful instrument for the purpose of testing cables for this heat. And so in the case of our own bodies there is going on as true a combustion as in the case of the burning candle. We take in food, it is conveyed into the blood, we breathe the oxygen of the air, that oxygen comes into contact with the food in the blood, and the food is there slowly burned, and consequently we are rendered warm. The heat of our bodies is derived entirely from this slow combustion.

Towards the close of the last lecture I passed on to a consideration of what heat does. The usual result, as I told you, is that bodies are made to expand with heat. I made several experiments in proof of this,—one with a very beautiful piece of apparatus made for me by Mr. Becker, by which we multiplied the action more than a thousandfold in order to enable you to see the expansion which occurred when I breathed against a pillar of lead. I now want to make clear to you the wonderful strength of this force with which bodies expand, and the wonderful strength of the force with which they contract. The forces which pull the atoms or molecules of a body together on its cooling are perfectly enormous. I will illustrate this by an experiment which you will understand by reference to this model. I place in a hole at the end of this iron bar a little piece of wood; you see the two ends of this piece of wood rest against these two edges; and if I pull the bar I break the piece of wood. You will observe that it first of all bends and then breaks. Now, what I am going to do is this: for this piece of wood I am going to substitute a piece of steel, and then I shall put a red-hot bar of iron across, and screw it on between these two points. It will cool, and the contraction will, I think, be so great as to break the bar of steel in the way in which I have broken this bar of wood. You see the construction of this iron apparatus is much the same as that of the model. [A red-hot bar of iron was screwed to the apparatus as described by the lecturer.] I will hasten the cooling by pouring a little water on the iron bar. [In the course of a few seconds the steel bar snapped.] There it is. The bar of steel is, in point of fact, smashed by the force with which the particles of the iron bar pull each other together when the motion of heat is taken away from them by cooling. That force is, as I have said, perfectly enormous.

Before we pass on to consider the expansion by heat of other bodies besides solid bodies, I should like to explain for the sake of the elder boys (not for the sake of the younger ones, because they will, perhaps, find it a little too difficult for them) the use of one term that is in common use in books that are written on the subject of heat. Suppose you have a piece of lead 3,510 inches in length, and suppose you augment the temperature of that lead one degree, you would find that its length would extend from 3,510 inches to 3,511 inches. That is it would extend $\frac{1}{3510}$ths of its length. This is the fraction of its own length which the lead expands on having its temperature augmented one degree. Now, that fraction is what is called the *co-efficient of expansion* of the lead. This co-efficient of expansion is much less in many bodies than it is in the case of lead. For iron this co-efficient of expansion is not half what it is for lead. This difference renders it needful for engineers to be very careful not to unite different metals which have different co-efficients of expansion in such a way that on their expansion they would produce distortion and disruption, and, perhaps, fracture. Here, for instance, is a ruler which has one side of brass and one of iron; and when it is heated, in consequence of the brass expanding more than the iron the ruler becomes curved or buckled up. Now, in an architectural structure different metals might be associated in such a way that on a change of temperature the edifice would be endangered in consequence of the metals expanding or contracting in different proportions. That fact is a very important one for architects to remember.

We will now proceed to a consideration of the expansion of liquids by heat. Here is a bottle containing water, another containing alcohol, and a third containing the liquid metal mercury. Here also is a bulb containing mercury. If I lay hold of this bulb the mercury within it expands, and this little column above the bulb is forced upwards. Now I want to show you, if I can, the motion of the mercury when the bulb is heated, and for that purpose I will throw an image of the column upon the screen. Now you have on the screen an inverted image t' of the mercury column $i\,i$, turned upside down by the lens L which you see in front of the lamp E, and I think you will see that when I heat the bulb, the column $i\,i$ will go towards the lower part of the screen, owing to the expansion of the metal. It really goes upwards, but it appears to go downwards, owing to the image being inverted. I will now place the bulb in hot water,—observe the motion which I indicated. I will now take a bulb containing the liquid alcohol, which is much more expansible than mercury. Mr. Cottrell has coloured it blue, that you may see it better than you would if it were not coloured. The colour indicates the column of liquid. At the first moment of the bulb being heated the column of liquid will appear as if it contracted instead of expanded. This apparent contraction is due to the fact that when we first plunge the glass vessel containing the alcohol into warm water that vessel itself expands, and becomes, in fact, of larger capacity, and thus the column of liquid sinks in it. This sinking, however, will immediately disappear, and then the blue liquid will go up in the tube far more rapidly than the mercury rose. I might take other liquids and show you the same effects, but we must now pass on to the question of the expansion of gases.

You will understand in a moment that gases are capable of expansion by heat. For instance, I have here (Fig. 2) an empty bottle F, to which is attached a tube; and Mr. Cottrell is now placing the end of that tube underneath this column of liquid $t\,t$. The column of liquid is supported by what the elder boys know as the pressure of the atmosphere upon the liquid outside. Now, if I heat this bottle I cause the air in it to expand: it will ascend with force into the tube $t\,t$, the water will descend, and in that way I think I shall be able to transfer the air from the bottle into the tube now containing the column of water.

Fig. 1.

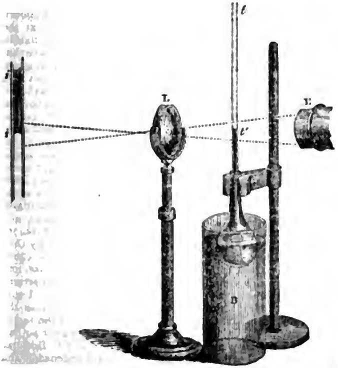
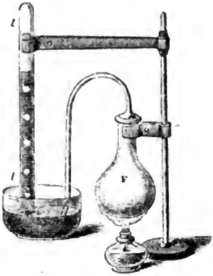


Fig. 2.



Observe now the bubbles of air going up, and pressing down the liquid column. This pressure is due to the expansion by heat of the air in the flask. I might continue this process until nearly the whole of the air of the flask was transferred to the other vessel.

In reference to this subject I might refer to this instrument, which is a thermometer made for the purpose of measuring heat by means of the expansion of air. Here at the top is a bulb filled with air. The liquid column now stands at a certain point. If I put my hand upon it the column descends. The warmth of my hand is causing the air to expand, and in doing that it drives down the liquid column.

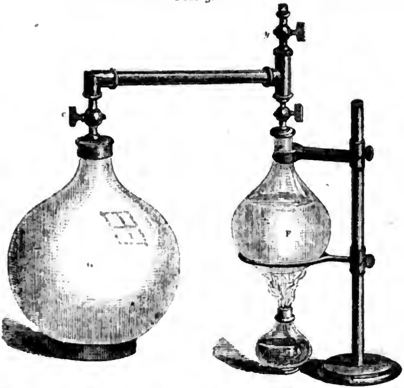
Before proceeding farther, I must say one or two words with regard to a term I have just employed. I have used the term "thermometer." That is, *a heat measurer*. I have made use of this bulb of mercury, and the tube attached to it, purely for the purpose of enabling you to understand the common thermometer. If you take this bulb of mercury and plunge it into melting ice, or into water just frozen, at any part of the earth's surface, you will always find that the column of mercury stands at precisely the same height, so that this temperature of frozen water or melting ice is the same thing all the world over. Here, then, we have, so to say, a standard of temperature. First, suppose that our bulb of mercury is plunged into melting ice: that will give the freezing point of water. Then plunge it into boiling water under the same barometric pressure, and the height to which the column will rise under such conditions will be the same all the world over; and that point will indicate the boiling point of water.

We have three different kinds of thermometers. First of all there is the thermometer of Fahrenheit. In constructing his thermometer Fahrenheit made use of a mixture of ice and salt, and he found that this mixture gave him a far greater cold than that of ice itself. He thought this was the greatest cold possible, and he therefore marked that temperature as the zero of his scale, and began to number his degrees from this zero which represented the temperature of pounded ice and salt. He then went upwards to the freezing point of water, which was 32 degrees above his zero. He then obtained the boiling point of water, and divided the distance between the freezing point and the boiling point of water into 180 equal parts or degrees. The 180 added to the 32 makes Fahrenheit's boiling point 212 degrees above his zero. The second thermometer is one which is in general use amongst scientific men, and I wish it was employed in all parts of the community. It is known as the Centigrade thermometer. This was invented by Celsius, and is sometimes called Celsius's thermometer. Here we have the distance between the freezing point of water and the boiling point divided into 100 equal parts or degrees. We have a third sort of thermometer which is known as Réaumur's. It is a very awkward one, but it is nevertheless used a great deal in Russia. In this instrument the distance between the boiling and freezing points is divided into only 80 different parts. The degrees in these three different thermometer's—Réaumur's, the Centigrade, and Fahrenheit's—are in the respective proportions of 4, 5, and 9. So much then for the terms "degree" and "thermometer" which have been used in these lectures.

Now, if possible, I should like to show you heated air. You cannot detect it by looking at it directly in the atmosphere, but it can be made evident by a device which I intend now to employ. I can show you this heated air rising up in streams from a heated body. Here is a hot spatula. If you look directly at this hot body you can see no emanation whatever from it; but now my assistant will throw a beam of electric light upon this spatula, and we will observe the shadow of it upon the white screen. You now see above the image of the spatula a stream of heated air rising from the hot surface. This effect is quite invisible when you look at the spatula in the ordinary way.

I want now to show you another stream of air. I have here the means of giving you a still greater stream of heated air; and I want to make you acquainted with the celebrated invention of that eminent man, Mongolfier. He conceived the idea of catching these streams of heated air in a bag, and in this way the bag was carried up. From the chimney of this stove we get a stream of heated air. You observe by the effect on the screen how powerfully that stream is rising. I have here a paper balloon, and in this balloon I will catch the column of heated air. If I am successful we shall by-and-by get the balloon filled with the hot air, and then we shall make Mongolfier's celebrated experiment. You see the sides are swelling by this heated air being accumulated inside the balloon. I will now let it go out of our hands, and I venture to say it will sail upwards. There it goes. It has not gone so high as it ought to have gone, but still it will answer for philosophers as an illustration of the balloon of Mongolfier.

Fig. 3.



It is found that in the case of solids and liquids the expansion is exceedingly irregular, The co-efficient of expansion varies very much. But strange to say—(and I wish I could go into the reason and tell you why)—in the case of really perfect gases it is essentially the same for all. If you take 490 cubic inches of air and heat it one degree it becomes 491 cubic inches, so that the fraction $\frac{1}{490}$th is the co-efficient of expansion of air; and this co-efficient, as I have said, is almost exactly the same for all gaseous bodies whatever.

Now I have to direct your attention to some experiments with regard to the action of heat upon liquids; and with this view I have provided an apparatus (Fig. 3) which I will now ask Mr. Cottrell, the assistant, to place upon the end of the table. I will now cause the water in this flask F to boil, and I want to show you now what is meant by the vapour of water. We will apply heat to the flask, in which is a quantity of water, and after a little time the water will boil and bubble up. I want you to understand accurately the meaning of this bubbling up. What is going on at the present time in that flask of water is this. The water is heated. As the heat becomes more and more intense this shivering, quivering, vibratory motion becomes more and more intense, and then particles of water are jerked away from the upper surface, and carried away into the space here above. After a time the water begins to bubble. Here you have the bubbles of steam rising to the top. Now, the surface of the liquid is in communication with the air. Every square inch of the surface of that flask of water bears a pressure of about 15 lbs. and every little bubble there bears a pressure of several pounds. Why is it that the bubbles are not crushed? Simply because the pressure of the vapour within them is exactly equal to the pressure of the atmosphere without, so that the film of liquid is squeezed between the air on the upper side and the vapour on the lower side. If you lessen the pressure of the vapour within, you will have the bubble crushed by the pressure of the atmosphere. The boiling point of a liquid is precisely that temperature at which the pressure of the vapour of a liquid equals the pressure of the atmosphere. Now, by turning this tap *y*, I have enclosed in the flask some heated water; and you see that at the present time it is quite quiescent. The vapour in the flask is pressing upon the surface of the liquid. But if I take that pressure away, I have no doubt that the water will again boil. How can I do this? I have in connection with this flask of water another globular glass vessel o from which the air has been drawn by means of an air-pump. Hence the inside of this globe is a vacuum. Now, if I turn the cock *c*, which is between the flask and the other vessel, I open a way for the vapour in the flask to go from the surface of the liquid into the vacuum. Observe what occurs. The liquid is relieved of the pressure which was upon it, the water begins to boil, and the flask immediately becomes filled with the vapour of the water. The sides are now quite clouded. We can actually boil that water by cooling it. If the water in the flask were near its boiling-point, and we plunge cold water upon the upper part of the flask, we should condense the vapour above the liquid, and by thus relieving the water of the pressure on it we should cause it to boil. Here I have a tin vessel containing steam, and the air from which has been chased away by the steam. Mr. Cottrell will place it in front of the table. I will withdraw it from the flame, and I will in fact cause the water in it to boil by placing a piece of ice on the top of the vessel. [This was done.] The water is now boiling away, as the boys near at hand can see. Why? Because the vapour above the water has been condensed, and when the pressure is then removed from the surface of the liquid, ebullition takes place. If more ice is placed on the top the water will boil still more, but the atmospheric pressure will, perhaps, crush the vessel entirely in. This effect will be due to the reduction of the pressure of the vapour on the inner sides of the tin vessel. [The effect anticipated was not produced, but the experiment was repeated at the beginning of the next lecture, and the sides of the tin can were then successfully crushed. The lecturer informed the audience that it had been found that the failure in the present instance was due to an accidental air hole in the side of the tin vessel.]

I have now to pass on to a consideration of the vapour of water. I have here the two gases or substances of which water is composed. I will show you first of all that one of these is a certain gas which is inflammable, and this gas we call hydrogen. Mr. Cottrell is now getting me some hydrogen which has been actually produced by the decomposition (to use a learned term) of water. He will now give me this gas. We hold downwards the mouth of the vessel containing it, as it is excessively light, and would escape if the vessel were held upwards. I will ignite this hydrogen, and you see what occurs. It is an inflammable gas. There it is burning with a flame at the top of the tube. Now the assistant will give me some of the other gas which is a constituent of water, and here we shall find our familiar friend oxygen—that gas which causes bodies to burn so brightly when they are placed in it. I will introduce into the oxygen a small bit of wood with an ember at the end; and what is the consequence? [The glowing wood immediately burst into a bright flame.] This gas is the other of the substances of which water is composed.

Now I will take the two gases mixed together, instead of having them in separate tubes. I have here a wonderful instrument [a galvanic battery], which enables me to tear asunder the particles of water. Mr. Cottrell will now connect the vessel of water with the battery, and we will let the decomposing gases escape into soap-suds. [The mixed gases from the decomposed water were caused to form bubbles with the soap lather. The lecturer then placed a cluster of the bubbles on the palm of his open hand, and exploded them by the application of a light.] How must you figure this act of the combination of hydrogen and oxygen? I suppose you must figure it in this way. You must figure them rushing together with a great clash, and then quivering and recoiling in virtue of their resilience—their elasticity. As far as I can follow the thing in my mind the flash is due to the collision between the particles of the oxygen and hydrogen. It is due mainly to the enormous heat produced by the collision; and the heat produced by this collision is so great that for a time the molecules of water produced are so hot that they are preserved in a state of invisible gas. Water is composed of oxygen and hydrogen in the proportion of two atoms of hydrogen to one of oxygen; and two atoms of hydrogen and one of oxygen constitute what is called a "molecule of water." *Molecule* is the term employed to express that combination, and you must remember the term.

I want to show you the difference between vapour and invisible gas. This room is filled with invisible vapour; but here, early in the lecture, I placed this vessel containing something very cold—a freezing mixture; and this frost which you see upon the outside of the vessel is due to the condensation of the aqueous vapour which has come from the gas-lights and from the lungs of the persons here present. That vapour has been condensed on the cold surface of the vessel containing the freezing mixture, and then frozen into hoar frost. The fog through which you were kind enough to come on Thursday last to this place was not a true vapour. It consisted of particles of water. Here you see the same thing. The steam which you see rushing from this vessel is not a true vapour. It is due to the vapour cooling and being precipitated. If I allow the steam to pass through this flame it is converted into a true vapour. The steam is now water—now vapour. [Passing the steam-jet through the flame, and thus rendering the steam invisible.]

After a time we shall have that vapour cooling and falling into the state of water, and then if we cooled that water still more the particles would bring other forces and powers into play; and those are the forces and powers that I now want to illustrate before you. I want to exhibit to you the marvellous force of crystallisation. When we cool water sufficiently it becomes, as every boy knows, reduced to ice. That ice is one of the most wonderful things on the face of the earth, and in another lecture I shall dissect a piece of ice and show you how wonderful it is. I want to show you something similar to what occurs on your chamber windows when they become frosted during the cold nights and covered with forms as beautiful as vegetable forms. I show you that in this way. If I took this piece of glass and poured a solution of common table salt upon it, and allowed it to remain, the water only would evaporate. The salt would be left behind incrusted on the surface of the glass. You can make the experiment at home with the greatest ease if you drop a little solution of sugar upon glass and allow it to stand. You get the water evaporated and the sugar remains behind. Now I want to do the same with a solution of another substance. First of all I must clean the glass plate perfectly, and this I do with potash; and then I shall put on it a film of a solution of something—not sugar, not salt, but something which will give me crystals more beautiful than either of them. We will take a liquid containing a certain kind of salt in solution, and I will pour this liquid upon the glass plate. I want to evaporate this film of liquid before you, and show you the crystallisation of the substance. [An image of the moistened glass plate was projected on the screen. Crystals began to appear in the course of a few seconds, and gradually spread over the surface of the plate.] See how splendidly these crystals form. See them building themselves together in this wonderful way as if they were forming vegetable growths before your eyes. This salt is ferrocyanide of potassium. We will take another plate, and cover it in the same way with a solution of chloride of ammonium. I will warm the plate in order to hasten matters. [This plate also was represented on the screen, and a similar result was obtained as in the last case.] How beautifully these crystals run together. There they are, darting out like spears. This is an experiment which one makes hundreds of times, but still it is sufficient to strike one with wonder. How beautifully the crystals assume their determinate forms.

One minute more. I want to tell you that in passing from the liquid to the solid state—in falling together so as to form those beautiful crystals—certain bodies, comparatively few in number, become larger. Water is one of these bodies, and that is the reason why ice floats upon the water. When water freezes it expands with powerful force. The bombshell which I placed in the bucket before you was, as you see, burst by the expansion of the water in the act of freezing.

Liebig's Extract of Meat.—The Government have contracted with Liebig's Extract of Meat Company (Limited) for the supply of the Company's extract to the troops of the Abyssinian expedition. The extract is packed in small jars which a soldier can easily carry with him, being enabled thereby to dispense with fresh meat for a number of days, and to cook a palatable soup in fifteen or twenty minutes at any halting place where hot water can be procured. The Government were no doubt guided in this decision by the experience gained in the last German war, it having been acknowledged by many officers and men that they owed to the use of this extract of meat the preservation of excellent health. In many cases, fresh meat distributed to the troops in the morning was spoiled by the effect of heat at the time it was wanted; the extract in all such cases proved an efficient substitute for meat.

ON THE
CHEMICAL CONSTITUTION OF FLUORINE COMPOUNDS,
AND ON THE ISOLATION OF FLUORINE.
By M. PRAT.

THE following is a full abstract of M. Prat's memoir on this subject, recently communicated to the French Academy. The complete paper will not be published until the chemical referees of the Academy have reported on it.

M. Prat considers that chemists have hitherto been mistaken as to the composition of fluorides and the theory of fluorine. He regards the fluorides as in reality oxyfluorides, and the equivalent of fluorine as consequently much higher than is usually supposed. He represents fluoride of calcium by—

2	equivalents of	calcium	40·0
1	"	oxygen	8·0
1	"	the new fluorine ..	29·6
			77·6

This accords with the known analyses of fluor spar, since it contains 51·5 per cent of calcium.

By doubling the old equivalent of fluorine (19), we get 38, that is to say nearly the sum of the equivalents of oxygen (8), and of the new fluorine (29·6) = 37·6.

According to M. Prat, in order to obtain true fluorine it suffices to heat fluoride of calcium with chlorate, or rather with perchlorate of potash, since it is only after the formation of this latter salt that the reaction takes place. Oxygen is disengaged and also a product which silver absorbs. The compound so formed is fluoride of silver, insoluble in water, soluble in ammonia, from which it is precipitated by nitric acid, and more rapidly altered in the light than chloride of silver. Neither chlorine nor oxygen attack it even at the fusing point of the fluoride. It is, however, decomposed by potash at a dull red heat, and this reaction permits its analysis: it contains—

Silver	0·785 ..	108·0	= 1 equivalent
Fluorine	0·215 ..	29·6	" "
Fluoride of silver	1·000	137·6	

This fluoride of silver, insoluble and very stable, and having great analogy with the chloride and the other compounds of this family, differs essentially from the soluble fluoride of silver of chemists, which according to M. Prat is a compound of—

AgFl, AgO, HO, in the hydrated state;
AgFl, AgO, in the anhydrous state.

Fluorine combines with chlorine. To obtain this compound it is sufficient to pour a weak solution of the hydrofluoric acid of the chemists into a solution of hypochlorous acid: there form

$$\mathrm{FlH, HO + ClO = 2HO + FlCl.}$$

Fluoride of chlorine is gaseous, of a more intense colour than chlorine. It converts silver into a mixture of chloride and fluoride.

Fluorine may be isolated, according to M. Prat, by heating fluoride of lead of chemists (1 part) either with nitre (5 parts) or with binoxide of manganese (2 parts); oxygen and fluorine are evolved. A platinum alembic must be used. The oxygen is removed from the mixture by passing over fragments of heated baryta.

Fluorine is gaseous, almost colourless, of a chlorous odour, visibly fuming in the air, incombustible, and heavier than air. It bleaches indigo, and reddens and bleaches litmus. Ammonia produces fumes with fluorine, and will thus detect traces of it. It immediately decomposes water at the ordinary temperature. It combines with hydrogen in diffused light. Fluorine decomposes hydrochloric acid gas, and eliminates bromine and iodine from their compounds. It unites with boron and silicium, and with all metals of the first five groups.

ON THE
MANUFACTURE OF STEEL FROM CAST IRON,
BY THE USE OF NITRATES AND OTHER OXIDISING SALTS.*
By J. HARGREAVES.

THE object of this invention is to effect the acieration of cast iron by a direct process, and thus dispense with the many permutations which it is at present made to undergo before the condition of steel is attained. I effect this by the agency of oxidising salts and oxides of iron and manganese. The oxidising salts which are most suitable for the purpose are the nitrates, and especially the nitrate of soda, on account of its lower cost, higher percentage of oxygen, and the highly electro-positive character of its base, which renders it a most effective agent in removing the metalloids, silicium, sulphur, and phosphorus, and the semi-metal arsenic from iron, by forming with them compounds of sodium, thus enabling inferior qualities of cast iron to be used in the manufacture of steel, and also to improve the qualities of malleable iron by depriving it of those objectionable substances. This is effected by placing the converting materials below the fused cast iron, and allowing the products of their decomposition to rise through the fluid metal, exerting while passing through it their chemical energies in separating from the cast iron the excess of carbon above that which is required to constitute steel, and in removing the metalloids which, even in the smallest proportions, deteriorate the value of the product.

The necessary use of fossil coal in Great Britain, in consequence of the scarcity of wood from which charcoal can be obtained, tends, while lowering the cost of production, also to deteoriate the value of the iron produced, by communicating to it some of its own impurities, which, added to those existing in the ore, render the iron very impure.

A great proportion of silicium and sulphur are separated by the lime used as a flux in the form of slag. But the last traces of these elements are very difficult to remove under the circumstances; while, with the exception of a slight trace, the whole of the phosphorus originally present in the ore remains in combination with the metal.

In 1861 my attention was first seriously attracted to the subject of the acieration of iron by the communications of the researches of MM. Caron and Fremy to the French Academy of Sciences, and which were published in the *Comptes Rendus*, an English translation of which first appeared in the CHEMICAL NEWS. These communications show that, to form steel with such qualities as will compete with that produced from Swedish and Russian iron, by cementation, it is necessary that the iron should be pure or approximately so; and that to effect cementation, nitrogen must be present in combination with carbon, or in contact with some gaseous compound of carbon. M. Caron disputes the hypothesis that nitrogen is an essential element in steel; but he admits that it acts as an inter-porter or carrier of carbon between the charcoal in the cementing pots and the iron, acting in fact as a kind of chemical shuttle, carrying carbon to the iron, and depositing it within the substance of the metal; and after delivering the carbon to the iron, it returns, and again picks up another charge or load of carbon, which it again delivers to the iron. A very small quantity of nitrogen is by this means made the agent for carrying a comparatively large quantity of carbon; and he proposes cyanide of ammonium as a gaseous cementing agent. M. Fremy, on the contrary, asserts that nitrogen is absolutely essential to acieration, and that in the absence of this element cast iron and not steel is the result of operating upon iron with pure carbon, unless the iron itself contains nitrogen. That iron can be made to combine with nitrogen has been placed beyond doubt by

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* Abstract of a paper read before the Liverpool Polytechnic Society.

M. Despretz, whom M. Fremy quotes and whose experiments he repeats, a ferammoninm (NFe_4) having in fact been prodnced; *i.e.*, a compound analogous to the quasi-metal ammonium in which the hydrogen is replaced by iron. M. Fremy proposes to effect the cementation of iron by the use of ammoniacal and hydro-carbon gases, to supply nitrogen and carbon. I was then, and am still, disposed to take the view of M. Fremy as the correct one. But the thought suggested to me by the discussion between these eminent savants, was—"Why not obtain and use some material which shall effect the removal of the excess of carbon, with all other objectionable elements, and at the same time add nitrogen, which being chemically very inert, must be in the nascent state to effect its combination with iron, instead of removing the whole of the carbon, and then by a very expensive, laborious, and inconstant process restore a portion of the carbon extracted and a very small portion of nitrogen?"

The great difficulty was to find an agent capable of fulfilling the requisite conditions, which are:—

1. That it shall remove any desired quantity of carbon, this being varied with the varying proportion of carbon contained in the cast iron, and leave in it just sufficient carbon to effect its acieration.

2. That it shall remove all the silicium, sulphur, and phosphorus, or at least leave only traces of these elements.

3. That it shall supply nitrogen in the nascent state.

I occasionally took up and studied the subject, but with no satisfactory result—as I could not see clearly how to have a practical process, which could compete with those then in operation—till in 1864, when considering the theory of the action of the alkaline nitrates upon the elements composing cast iron, I found that these salts possessed all the properties necessary to accomplish the object I then had in view.

1. The quantity of carbon to be removed could be regulated at will by the quantity of nitrate used.

2. The alkali would in all cases be in excess of the quantity required to form chemical compounds with silicium, sulphur, and phosphorus, and give rise to the formation of silicate of soda, sulphide of sodium, and phosphide of sodium.

3. Nascent nitrogen would be formed in the presence of iron, in consequence of the formation of cyanides, by the reaction of the sodium or potassium and nitrogen of the nitrate upon the carbon in the cast iron, and would also be liberated upon the decomposition of the oxides of nitrogen.

4. The reaction of the nitrate upon fused iron could be easily effected by placing the nitrate at the bottom of a suitable vessel, and allowing the products of its decomposition to rise through the metal.

Before describing the details involved in treating iron by this process, I beg to point out the general principles upon which it is based. You will have before observed, that to effect the removal of a given quantity of carbon from cast iron, a given quantity of oxygen must be supplied, to convert this carbon into carbonic acid, or carbonic oxide. To convert six parts of carbon into carbonic acid, sixteen parts of oxygen are required, and to form carbonic oxide, eight parts of oxygen combine with six parts of carbon, and in one or both of these forms the carbon is eliminated from the iron. The weight of oxygen contained in the acid of the nitrate of soda, and which will be eliminated from it, is equal to 47 per cent; binoxide of manganese yields about 36½ per cent, and sesquioxide of iron 30 per cent. It thus becomes tolerably easy to ascertain, especially after a few practical trials, the proportion of oxidising materials necessary to remove a given quantity of carbon. This is, however, complicated by some conditions, each of which requires a trial or two to obtain exact results. For instance, when the operation is carried on in a deep vessel, the oxidising materials act more effectively than when a shallow vessel is used, because the products of their decomposition have more time to become saturated with the impurities which it is desirable to remove from the iron. The rate of evolution of the gases from the oxidising material is regulated by the proportion of oxide of iron, of oxide of manganese, mixed with the nitrates. These oxides, though themselves evolving oxygen, especially in the presence of carbon, do so tardily: and they restrain the otherwise uncontrollably rapid action of the nitrates alone. By this means the action of the nitrate can be so retarded as to cause only a comparatively slight ebullition. The nitrate of soda is mixed with a proportion of oxide of iron, the most suitable form of which is hæmatite, and when in a slightly moist condition, passed or tamped into the bottom of a vessel lined with fire-brick; the whole is then dried into a solid block. If the vessel has been used immediately before, its heat will be sufficient to dry the mass, but if not heated by a previous operation, it is heated by other suitable means. The nitrate of soda of commerce is generally sufficiently moist, without the addition of more water. When the mass is dry, the fused iron is poured upon it; successive layers being then removed, the materials by their levity are carried through the body of the metal, and the reactions occur, to which I have before referred; and as each layer is removed, the part immediately below is exposed to the heat of the melted metal. A boiling appearance accompanies this action, and a frothy slag containing some oxide of iron, and compounds of soda, with the impurities extracted from the iron, rises to the top. After the action has ceased, in consequence of the converting materials being expended, the steel is tapped out, and made use of in any suitable way.

Refined iron, for the manufacture of malleable iron in the puddling furnace, may be made by the use of about 3 per cent of nitrate and 6 per cent of peroxide of iron. Steel, by 8 to 10 per cent of nitrate and equal weight of binoxide of manganese. Malleable iron by 8 per cent of nitrate and 20 per cent of peroxide of iron. In each case iron with 5 per cent of carbon being used.

But it was often suggested to me that the use of separate and special apparatus is objectionable, on account of its expense, as manufacturers are generally averse to any large outlay upon new processes; and that some mode of applying it to the ordinary puddling furnace would be very useful. But there was this difficulty to contend with, the puddling furnace is too hot for the introduction of the converting materials, and fixing them at the bottom, and could this be done they would be decomposed before the fusion of the iron could be commenced, to say nothing of their remaining till it could be melted, so as to allow the gases evolved to rise and act through the fluid metal. I get over this difficulty as follows:—I make the converting materials into blocks or balls, and fix them on the ends of iron rods. These balls being made hard by drying, are ready for use. When the iron is fused in the puddling furnace, and the boil has commenced, one of these balls is pushed to the bottom of the metal in the furnace—the products of its decomposition rise through the metal, causing rapid agitation, which is much more effectual than that produced by the puddler with his tools. After the ebullition has ceased, the rod is withdrawn and another put in its place. The time occupied in puddling is thus very much shortened, the labour very much reduced, fuel saved, and a better yield of metal obtained, in consequence of the soda forming a base which readily combines with the silicic and phosphoric acids eliminated from the iron. In the ordinary puddling operations the silicium and phosphorus are extracted by the previous formation of oxide of iron, with which those acids, which are also products of oxidation, combine. But when silicium and phosphorus are reduced to a somewhat small proportion of the whole, the last traces of them are removed with difficulty, still the powerfully basic character of the soda intensifies the disposition of these substances to separate from the iron, and to enter into combination with itself.

The malleable iron produced from cast iron which has been treated with nitrates is of a very superior quality, having great range of temper. The same metal which by gradual cooling is fit for purposes requiring great toughness and powers of endurance of bending and torsion, may by rapid cooling be made sufficiently hard for wood-cutting tools; and its freedom from impurities is shown by the remarkably thin scale formed when the iron is worked by the smith, and the consequently small amount of loss in working. In this respect it very much resembles the best charcoal iron, and contrasts very remarkably with the iron made from the same "pig," but which has not been previously treated with nitrates. The presence of silicium causes a large amount of waste when malleable iron is exposed to the atmosphere at high temperatures, causing a thick, heavy scale, which must contain at least 70 per cent of iron.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, December 24th, 1867,

E. W. Binney, F.R.S., F.G.S., Vice-President, in the Chair.

"*On the Examination of Water for Organic Matters,*" by Dr. R. Angus Smith, F.R.S.

The author repeated his opinion that the mere expression organic matter had no such meaning as would allow chemists to measure the impurity of water by its amount. He went more fully into the division of the organic matter into various portions, some acting as unwholesome agents, others being entirely innocent. He said he was glad to find that other chemists were also attending to the quality as well as the quantity of the organic matter, and he insisted also on the condition of the matter being observed. He discussed the methods of Professors Frankland and Wanklyn, considered, however, that they did not supersede his own methods, which made a greater number of subdivisions. He explained the mode in which the organic matter is entirely removed from water, leaving frequently none of its elements behind, unless we include amongst them the inorganic bodies with which they were combined. The body which remains is chiefly common salt, which cannot be removed, and by which more than any other substance animal matter is to be detected in water under certain precautions. He also showed the importance of finding the amount of atmospheric oxygen in water, and its meaning; but as the paper was not concluded the notice is here left incomplete.

FOREIGN SCIENCE.

Paris, Jan. 8, 1868.

Fluosalts of antimony and arsenic—Detection of salicine in quinine—New reaction for alkalies and alkaline earths—Method of estimating sulphur in iron.

So many contradictory conclusions have been arrived at by different investigators with regard to the fluorine compounds, that English chemists will have noticed with pleasure the mention made in my last letter of M. Marignac's research. The former researches of this chemist on the fluorides of niobium and tantalum led to the conclusion that they contained five atoms of fluorine. It appeared to him interesting to study the analogous combinations which antimony and arsenic seemed capable of forming. The hope of meeting in these compounds relations isomorphous with the fluoniobates and fluotantalates has not been realised: the question, however, still remains somewhat uncertain, by reason of the very restricted number of fluantimoniates and fluarseniates which it is possible to obtain well crystallised.

The antimonic fluoride M. Marignac has not been able to obtain crystallised; its solution, evaporated quickly in the cold, becomes syrupy. If heated, it decomposes, forming a white insoluble deposit, which is probably an oxyfluoride. By adding potash, soda, or ammonia to the acid solution of this fluoride and concentrating, crystals may be obtained. These fluantimoniates are deliquescent. Neither acids nor alkalies precipitate their solutions. The alkaline carbonates, after a considerable time, cause a precipitate in the cold—speedily upon boiling. The crystallised salts dissolved in water exhale the odour of hydrofluoric acid; by dissolving and evaporating repeatedly, several of these salts pass into the state of fluoxyantimoniates. M. Marignac has only studied the alkaline fluantimoniates, not having been able to obtain the others crystallised. The following is the analytical process adopted:—The water is determined by calcination with pure anhydrous protoxide of lead. For the estimation of the antimony and alkaline metal sulphuric acid is added in excess, and heat applied until the whole of the hydrofluoric acid is expelled. Fluoride of antimony is not disengaged under these circumstances. The residue is suspended in water, and a current of sulphuretted hydrogen passed through the milky fluid. It is necessary to digest the fluid with the reagent for a long time before filtering. The antimony is determined in the sulphide collected, and the filtered solution is evaporated, ignited, and the alkaline sulphate obtained, weighed.

The fluorine in these compounds must be estimated, at least approximately, to distinguish the fluantimoniates from the fluoxantimoniates. The following is the method which M. Marignac employs to effect this; he is aware the results it gives are not quite satisfactory:—A solution of pure sulphydrate of sulphide of calcium is prepared by passing sulphuretted hydrogen gas into pure milk of lime. For the analysis of 1 gramme of fluosalt the lime required is obtained by the ignition of 2 grammes of pure carbonate of lime. The filtered solution of the calcium sulphide is mixed with the solution of the fluantimoniate, and 1 gramme of pure carbonate of potash is added. A precipitate of fluoride of calcium and carbonate of lime results, the alkaline sulphantimoniate remaining in solution. The precipitate is treated by the method of H. Rose for the determination of the weight of the fluoride of calcium. The solution can be precipitated by dilute acid, and the antimony determined again.

Monopotassic fluantimoniate is obtained by dissolving antimoniate of potash in hydrofluoric acid, and concentrating the solution. It is anhydrous, and possesses the composition $SbFl_5, KFl$.

Bipotassic fluantimoniate is produced when a solution of the preceding salt is added to an excess of fluoride of potassium. It forms shining crystals; heated to 90°, they fuse in their water of crystallisation; becoming dry they lose water and hydrofluoric acid. The residue is not entirely soluble in water, a gummy substance remaining which retains fluorine. Analysis leads to the formula

$$SbFl_5, 2KFl + 2H_2O$$

Monosodic fluoxyantimoniate is obtained on adding carbonate of soda to a solution of antimonic fluoride containing excess of hydrofluoric acid. By concentration, the solution yields little crystals which are regular hexhedral prisms, terminated sometimes by a very acute rhombohedron, sometimes by a six-sided pyramid. The salt is very deliquescent. The determination of the antimony, sodium, fluorine, and water yielded numbers closely agreeing with the formula

$$SbOFl_3 + NaFl + H_2O.$$

Monosodic fluantimoniate results from the solution of the preceding salt in hydrofluoric acid. Crystals are deposited upon concentrating, which at first sight would appear to be cubes. They possess the property of double refraction. The composition of the salt is expressed by the formula

$$SbFl_5, NaFl.$$

Monammonic fluantimoniate forms slightly deliquescent acicular crystals—hexagonal prisms terminated by rhombohedrons. Analysis showed this salt to contain no water of crystallisation; the numbers obtained agreed with the formula $SbFl_5, NH_4Fl$. By adding to a solution of this compound ammonic fluoride in excess, and evaporating, rectangular plates are obtained which are the biammonic fluantimoniate. Analysis leads to the formula

$$2(SbFl_5, 2NH_4Fl)+H_2O.$$

M. Marignac finds the fluarseniates to be even more soluble than the fluantimoniates, and more difficult to obtain in the crystalline state. The ammoniacal salts are only obtainable as gum-like masses. Sulphuretted hydrogen decomposes the fluarseniates, but only slowly. At the end of two days the precipitation is not complete. They may be analysed by a method similar to that indicated for the fluantimoniates. No loss of arsenic is sustained in heating with sulphuric acid under redness. These salts are capable of preservation in the dry state, but their solutions evolve hydrofluoric acid, and then furnish by concentration fluoxyarseniates. Monopotassic fluarseniate is obtained by dissolving arseniate of potash in hydrofluoric acid. It crystallises out upon concentrating the solution. Analytical results correspond with the formula

$$2(AsFl_5, KFl) + H_2O.$$

Upon heating water and hydrofluoric acid are disengaged.

When arseniate of potash is dissolved in an insufficient quantity of hydrofluoric acid, the corresponding fluoxyarseniate is formed; it may also be obtained by acting repeatedly upon the preceding compound with water. The composition is expressed by the formula $AsOFl_3, KFl + H_2O$. Heated in a tube it melts easily, evolving hydrofluoric acid vapours abundantly. Bipotassic fluarseniate results when excess of fluoride of potassium and hydrofluoric acid are added to a solution of the monopotassic fluoxyarseniate. Analysis yielded numbers agreeing with the formula $AsFl_5,2KFl + H_2O$. Bipotassic fluoxyarseniate is produced when the preceding salt is submitted to repeated solution and evaporation; it is also formed when neutral fluoride of potassium is added to a solution of monopotassic fluoxyarseniate. Analysis leads to the formula $As_2OFl_8,4KFl + 3H_2O$.

Mr. Bœttger has discovered a reaction of great sensitiveness for alkalies and alkaline earths. He finds an alcoholic extract of the leaves of the ornamental plant known as *Coleus Verschaffelti*, possesses the property of becoming green under the influence of alkalies. To prepare this reagent, the fresh leaves are agitated with absolute alcohol mixed with a few drops of sulphuric acid, and left digesting for 24 hours; paper soaked in the tincture becomes red, and strips of this paper are the media of applying the test. This reagent is not influenced by carbonic acid, so that the earthy carbonates contained in water may be detected with it. The sensitiveness of the reagent is so great that a strip of the test-paper presented to a jet of coal gas speedily becomes green from the presence of ammonia.

M. Parrot has indicated a method of detecting the presence of salicine in the sulphate of quinine. In effecting this he takes advantage of the action of chromic acid on salicine; by his process a quantity as small as ¼ per cent is discovered. To make the examination, the quinine salt is introduced with a little water into a flask, 2 c.c. of sulphuric acid, diluted with 4 parts of water are added, and 4 c.c. of a concentrated solution of bichromate of potash. To the flask is fitted a curved tube which dips into a few grammes of distilled water contained in the little flask serving as receiver. Heat is applied; at the end of three of four minutes, hydride of salicyle is produced which distils. By adding to the water in the flask a few drops of solution of perchloride of iron, a more or less deep violet colour is developed.

M. Eggertz has published a paper on a method of estimating sulphur in iron and its ores. This paper is one of great practical value, and your correspondent is engaged in making a full translation which you will receive shortly; it is, therefore, unnecessary to outline the process in this place. M. Kopp prefaced it by a few sentences eulogising M. Eggertz's services in the improvement of the quantitative methods of analysing iron.

CORRESPONDENCE.

NEW VOLUMETRIC ASSAY OF IRON.

To the Editor of the Chemical News.

Sir,—The two methods at present known, viz., that by the bichromate of potash, known as Dr. Penny's process, and that by the permanganate of potash, which are both based upon the same principle of the oxidation of a ferrous solution and its consequent conversion into a ferric one—involve the necessity (to the travelling chemist) of carrying about a large quantity of expensive and unstable standard solutions, or the trouble and inconvenience of dissolving fresh portions of the crystallised reagent, whenever required, upon the spot.

A little circumstance which occurred at Cawnpore, in 1862, suggested to me another and apparently more simple method, which I beg to recommend to chemists and assayers, especially those travelling in out-of-the-way countries. You are aware that rooms in India are floored with a substance called "chunam," which is a kind of hydrate of lime. In a room of this kind, without a carpet, I was amusing my children by showing them the beautiful deep red colour which a drop of the solution of sulphocyanide of potassium bestows upon one of peroxide of iron, and which I told them (in fun) was "the blood of the theatres." A few drops of the red sulphocyanide of iron happening to fall upon the lime floor, I observed that they were immediately decolourised, and this naturally led me to make an experiment similar to that upon which Parkes' volumetric assay of copper is based.

I dissolved some sulphate of iron, "green vitriol," in distilled water, and added a few drops of nitric acid to peroxidise the solution, to which a single drop of the sulphocyanide solution was then sufficient to impart a deep red colour. This colour I removed effectually by the addition of about half the quantity of common lime water, leaving a perfectly clear solution. I have not had time or opportunity since to carry out the experiment to a practical result by standardising a solution of lime with one of sulphocyanide of pure iron (piano wire); but I hope shortly to do so, and, in the meantime, would feel much obliged by the opinion of better chemists than myself if there is any difficulty or serious objection in the way of such a process? If not, there can be little doubt that it would form the most simple and economical method of assaying iron ores, as lime water is procurable in almost any part of the world, and the quantity of sulphocyanide of potassium required is extremely small.—I am, &c.,

W. A. Ross, Captain, R.A.

Woolwich, 28th December, 1867.

FRICTION IN VACUO.

To the Editor of the Chemical News.

Sir,—In the very interesting lectures by Dr. Tyndall, now appearing in your columns, an experiment is attributed to Sir H. Davy which was made long before his time. I allude to the friction of flint and steel *in vacuo*. We owe this remarkable experiment, not to Sir H. Davy, as stated in the lecture, but to Hauksbee, who communicated it to the Royal Society in 1705, as I have shown in my work on "Phosphorescence," p. 204. In Hauksbee's experiments, as described in the *Philosophical Transactions*, when the receiver was well exhausted of air, then, although a more violent motion was given to the steel than before, yet not the least spark appeared to be struck from it, "but a small continued light was visible on the edge of the flint that was rubbed by the steel." On admitting the air the sparks re-appeared.—I am, &c.,

T. L. Phipson, Ph.D.

The Cedars, Putney, S.W., Jan. 4, 1868.

IS HEALTHINESS DEPENDENT ON STRATA?

To the Editor of the Chemical News.

Sir.—In the report of the meeting of the Local Board of Health of this town the following paragraph appears:—"The surveyor said that Dr. Buchanan, from the office of the Privy Council, waited upon him to make inquiries respecting the nature of the soil at Sheerness. By permission of Messrs. Ward and Brightman he had shown that gentleman the different strata forming the soil of Sheerness. Dr. Buchanan has now stated that after a careful examination he is convinced that in Sheerness there are fewer cases of consumption than in any town in England, and as a whole that Sheerness is one of the most healthy places in the kingdom." If I read correctly it seems that the healthiness of a place is dependent somewhat on the strata of the locality. Can you, or any of your readers, give me any information or the name or any work in which the subject is treated on? Ague is very prevalent here, and two medical gentlemen inform me that they always endeavour to remove, as soon as possible, all consumptive persons from Sheerness, which perhaps to a certain extent may account for the few cases of consumption mentioned by the authority in question as found in Sheerness.—I am, &c.,

John Bray.

Mile Town, Sheerness, Dec. 21, 1867.

MISCELLANEOUS.

Average Composition and Quality of the Metropolitan Waters during the Year 1867.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by Ignition.*	Oxidisable organic matter.†	Hardness.		Organic and other ammonia.
				Before boiling.	After boiling.	
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.	Grns.
Grand Junction .	20·29	1·07	0·700	13·0	4·2	0·003
West Middlesex .	19·34	1·05	0·747	12·5	4·1	0·003
Southwark and Vauxhall .	19·47	0·99	0·816	12·9	4·1	0·003
Chelsea	20·20	1·19	0·794	12·7	4·1	0·003
Lambeth	19·92	1·18	0·817	12·9	4·0	0·003
Other Companies.						
Kent	27·32	0·76	0·184	16·6	7·7	0·002
New River . . .	18·45	0·86	0·403	12·5	4·0	0·002
East London . .	20·15	1·06	0·624	12·7	4·4	0·003

The fluctuation in the amounts of the several constituents have not been considerable, but the proportions are always a little above the average during the early months of the year when there is much rain, and they are below the average in the dry summer months. The Kent water is always remarkable for its beautiful blue colour when seen in large volume, on account of the nearly total absence of organic matter, it being derived from deep chalk wells.

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* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxidisable organic matter is determined by a standard solution of permanganate of potash—the available oxygen of which is to the organic matter as 1 is to 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

Quality of the Gas supplied to the City of London.—Dr. Letheby reports that in the course of the quarter which expired on the 30th November last, 669 examinations were made of the illuminating power of the gas supplied to the City; each of the examinations was the mean of ten observations, and they were made in accordance with the instructions of the Act of Parliament. The following are the results:—

Illuminating Power in Standard Sperm Candles.

	Great Central Gas.	Chartered Gas.	City Company's Gas.
Maximum.. ..	16·52	16·36	15·69
Minimum.. ..	12·02	12·57	12·00
Average	13·96	14·31	13·75

It thus appears that the illuminating power has been constantly above the requirements of the Act of Parliament, and to the extent of about two candles. In the corresponding quarter of last year, the average illuminating power of the Great Central Gas was 13·89 candles; of the Chartered Gas, 14·19 candles; and of the City Company's Gas, 14·17 candles, all of which numbers are close to the averages of the present quarter. The chemical quality of the gas, as regards the amount of sulphur contained in it, has not been so satisfactory, for, excepting the Chartered Gas, the quantity of sulphur has generally been excessive. This will be seen from the following table:—

Grains of Sulphur per 100 cubic feet of Gas.

	Great Central Gas.	Chartered Gas.	City Company's Gas.
Maximum.. ..	34·61	26·30	30·58
Minimum.. ..	12·74	11·35	14·19
Average	21·87	11·73	22·97

In fact, of the 61 observations made during the quarter of the City Company's Gas, 42 were found to be in excess of the quantity sanctioned by Parliament. Of the 60 observations of the Great Central Gas, 41 were in excess; and of the 61 of the Chartered Gas, only 21 were in excess. The gas of each of the Companies has been at all times free from sulphuretted hydrogen, and, with the exception of the Chartered Gas, it has also been free from ammonia. The pressure at which the gas has been delivered to the laboratory has been rarely under an inch of water.

The Value of Milk as an Article of Food.—Mr. Horsley, analyst to the county of Gloucester, in a paper on this subject, says that a milk may be of high density and yet give but comparatively little animal matter, such as cream and casein, whilst the amount of lactine retained in solution in the whey may be greater than usual; on the other hand, a sample of milk may be of lower density and yet yield far more animal matter than ordinary, though each may be perfectly genuine; the difference in the relative value of the constituents depending much on the time of year, the mode of keeping and feeding the cow, &c. He found only one degree of difference between a sample purchased at Cheltenham and a sample supplied to the workhouse, but an analysis of the two specimens shows not only a vast difference in the amount of solid matter, but also that very little reliance can be placed in any of the instruments usually employed in determining the value of milk; for the fatty matter of the milk, unlike any other aqueous solution, helps to keep up the instrument, and gives no idea of the actual density of the sample nor of its value.

MEETINGS FOR THE WEEK.

Monday.—Geographical, 8½ p.m.
Tuesday.—Photographic, 8 p.m.
Wednesday.—Meteorological, 7 p.m.
—— Society of Arts, 8 p.m.
—— London Institution, 6½ p.m.
Thursday.—Royal, 8½ p.m.
—— Chemical, 8 p.m. "On Water Analysis," by Dr. Frankland, F.R.S. "On Isomeric Modifications of Valeric Acid," by Mr. A. Pedler.
Friday.—Royal Institution, 8 p.m. "On Faraday as a Discoverer," by Dr. Tyndall, F.R.S.

CONTEMPORARY SCIENTIFIC PRESS.

Under th heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Dingler's *Polytechnisches Journal.*

August, 1867.

H. Gruneberg, "On the Occurrence of Phosphorite in Nassau." A. Wagner, "On the Chemistry of the Revivification of Oxide of Iron as used by R. Laming for the Purification of Coal Gas." Bottger, "On the Colouring Matter of the Leaves of *Coleus Verschaffelti* as a delicate Test for Alkalies and Alkaline Earths." A. Siersch, "On the Action of Common Salt on Zinc and Oxides of Zinc." Mulder, "On a Method of Decolourising drying Oils." "On the Use of Creosoted Lime for keeping Fruit fresh." Kuhr, "A new Marking Ink." G. Lunge, "On the Depth of the Sea."

September.

C. Aubel, "A new Method of Estimating Dioxide of Copper in Refined Copper." A. E. Nordenskjold, "On Selenium and Thallium Ores (Crookesite, Eucairite, and Berzelianite) from the Skrikerum Mine." "On the Use of Creosote for protecting Timber against the Teredo."

Comptes Rendus.

September 16, 1867.

A. W. Hofmann, "On a new Series of Homologues of Hydrocyanic Acid." Niepce de Saint-Victor, "On some newly discovered Chemical Effects of Light." Berthelot, "On the Hydrocarbons of Coal Tar: Acenaphthene and Anthracene." Prat, "On the Chemical Constitution of Fluorine Compounds."

September 30.

A. W. Hofmann, "On the Preparation of Methylic Aldehyd, by passing Atmospheric Air charged with the Vapour of Methylic Alcohol over Incandescent Platinum." Secchi, "A Resume of the Author's Researches on Stellar Spectra." Melsens, "On the Passage of projectiles through resisting Media." Morin, "Remarks on the preceding Memoir." Chevreul, "Remarks. *apropos* of Melsens' Paper, on Mariotte's Experiments showing that Rain Drops and other falling Bodies carry with them a certain Quantity of Air, and on his Explanation of the Mode of Action of the Trompe." A. Riche, "Researches on the Hypochlorites, and on the Chlorides used for Bleaching."

October 7.

A. Donne, "On the Production of Organized Bodies during the Putrefaction of Eggs." Poznanski, "On the Use of Hydrocyanic Acid as a Remedy for Cholera and other Diseases." Faa de Bruno, "On a Portable Mercurial Barometer." Balsamo, "A Method of Depositing Designs in Relief by Voltaic Electricity without the Use of Stopping-out Varnish."

Bulletin de l'Academie Royale de Belgique (Classe des Sciences.)

August 3, 1867.

Schwann, "Report on E. Husson's Chemical and Physiological Researches respecting the Action of Alkaline Silicates on the Animal Economy." Gluge, "Report on the same Memoir." Melsens, "Report on the same Memoir." Kekule, "Report on W. Körner's Paper on the Synthesis of Anisic Acid, of Methyloxybenzoic Acid, of a new Cresylic Acid, and on Paraiodobenzoic Acid." "Report on Glaser and Radziszewsky's Memoir on some Transformations of Formobenzoic Acid." Stas, "Report on the same Memoir." Kekule, "Report on Korner's Contributions to the Determination of Chemical Position in the Aromatic Series." Stas, "Report on the above Memoir." Kekule, "Report on H. Ronday's Memoir on Homotartaric Acid." Stas, "Report on H. Ronday's Memoir on Itamalic Acid." "A. Kekule, "On the Sulphophenic Acids." E. Husson, "Researches on the Action of Alkaline Silicates on the Animal Economy." W. Korner, "Note on the Synthesis of Anisic Acid, of Methyloxybenzoic Acid, of a new Cresylic Acid, and on Paraiodobenzoic Acid." Glaser and Radziszewsky, "On some Transformations of Formobenzoic Acid." W. Korner, "Contributions to the Determination of Chemical Position in the Aromatic Series." H. Ronday, "Note on some Salts of Itamalic Acid." "Preliminary Note on Homotartaric Acid."

Journal für Praktische Chemie.

September 24, 1867.

F. Stolba, "On Silicofluoride of Rubidium." On Crystallised Silicofluoride of Copper." F. Rochleder, "On Aescigenine, and on two allied Substances—Caincine and Chinovine." A. Claus and C. Reese, "On Neurine and Sincaline." "R. Otto and H. Ostrop, "On the Action of Chlorine on Sulphobenzide." H. Vohl, "On some hitherto unknown Properties of pure Naphthalin." "On the Detection of Naphthalin." "On the Preparation of Sulphide of Copper and Ammonium." C. Winkler, "A Method of Preparing Hydriodic Acid." K. Haushofer, "On some Malacolite from Gefrees, Bavaria." "On some Glauconite from the *Cénomanien* at Havre." F. Reindel, "On Prussian Blue." "On some Compounds of Ferrocyanides and of Ferricyanides." A. Froehde, "On the Part which Nitrite of Ammonia plays in Nature."

Bulletin de la Société d'Encouragement.

August, 1867.

G. de Clauby, "Report on P. Havrez's Improved Arrangement of Lixiviating Apparatus in which a Single Distributing Cock is employed." Salvetat, "Report on Brianchon's Pearl Glaze for Glass and Porcelain." Assmus, "On the Manufacture of Caramel." J. Stinde, "On the Manufacture of Formic Ether. J. Feuquieres, "On the Electrolytic Deposition of Tin on Lead which will bear Rolling." "On the Electrolytic Deposition of Iron of Great Hardness." Troost, "On Obtaining Steel from Cast Iron by the Action of a Current of Oxygen.

Journal des Fabricants de Papier.

September 1, 1867.

E. Bourdilliat; "On Testing the Chemical Products used in Paper Making. (Continuation.) Bichromate of Potash. Acetate of Lead. Litharge. Chlorides of Tin." "On the Use of Sulphite of Lime as an Antichlore.

No. 18. September 15.

E. Bourdilliat, "On Testing the Chemical and other Products used in Paper Making. (Continuation.) Animal and Vegetable Fibres."

Bulletin de la Société Industrielle de Mulhouse.

August, 1867.

J. Thomas, "On a new Colouring Matter derived from *Sericographis mohitli.*

NOTES AND QUERIES.

Mordant for Green on Cotton.—Could you kindly inform me through your Chemical News what is the best mordant for dyeing the new greens on cotton yarns?—W. T. C.

Bleaching Calico.—Can any one inform me, how far in bleaching calico, the bleaching powder solutions are exhausted? Can they be refreshed with new powder *ad infinitum*, or must they be thrown away when a certain quantity of fabrics has passed through them? If so, is there any practical rule for guiding the manufacturer, such as the observation of the specific gravity of the solution? It appears some bleachers exhaust their solutions much more than others.—G. L.

Deodorising Petroleum.—Your correspondent O. P. A., desires to receive information on the preparation of "plumbate of soda," its use and application in deodorising petroleum; when oxide of lead or litharge, is added to a pretty concentrated solution of caustic soda, the oxide of lead is dissolved therein, and may be considered to play towards the soda the part of an acid; the clear solution may be used with advantage to deprive petroleum of some foul smelling compounds it may happen to contain, especially as sometimes occur organic sulphur compounds, by thoroughly shaking and mixing the petroleum with the plumbate of soda, and afterwards giving sufficient time for the liquids to separate in two layers; the upper layer being the petroleum, the latter will have to be washed with water to remove the adhering soda, and should then be deprived of moisture by applying lumps of caustic lime.—Dr. A. A.

TO CORRESPONDENTS.

S. Scott (Calcutta).—Your letter has arrived. There will be great difficulty in getting what you require, but we will try and send it in the course of a mail or two.

T. Sterry Hunt (Montreal).—Arrived too late for insertion in this number. It shall appear next week.

S. Maldon.—You must use the best charcoal iron. "Pig" is too impure.

Physicist.—The exact equivalent of heat is 772 foot-pounds, according to Joule's most recent researches. The probable error is considerably less than 1 lb.

W. Murray.—Dr. Phipson has detected the presence of xanthic oxide in guanos which contain no uric acid.

Querist.—The colour of green pickles may be greatly improved by previously boiling the vegetables in water containing a quarter of an ounce of liquid ammonia to the quart.

Carbo.—Permanganic acid is volatile but very unstable. You will not be able to make use of this property in separating manganese quantitatively from iron.

Exhibit.—The list of jury awards in class 2, section A, was given in the Chemical News, vol. vi., p. 62, *et seq.*

Dr. Wilhelmi.—The price of the German edition of "Gerschichte der Chemie," by Dr. T. Gerding, 1s 9s.

W. Davies.—The best practical information which we know of on the subject of grinding lenses is given in a little work published by Secretan, of Paris, entitled "De la distance Focale des Systémes Optiques Convergents." The price is about 2s. 6d., or 3s.

Communications have been received from J. Heywood; A. Stark; L. Power; F. C. Calvert & Co. (with enclosure); Townsend & Adams; E. A. Parnell; Prior of the Monastery of St. Joseph; G. Lunge; Kingsbury & Co.; Dr. Adriani; C. J. Woodward (with enclosure); P. J. Worsley; Runcorn Soap and Alkali Co. Lim.; S. Rowland (with enclosure); M. A. Gage (with enclosure); Capt. W. A. Ross, R.A. (with enclosure); A. W. Wilson; A. M. Scott (with enclosure); W. Briggs (with enclosure); Dr. Quesneville; S. Scott; Molson, Bros. (with enclosure); Montgomerie & Greenhorne; T. Hill (with enclosure); H. R. Marsden (with enclosure); R. C. C. Lippincott; F. C. Clayton (with enclosure); T. Fisher (with enclosure); Professor Frankland, F.R.S.; Professor W. A. Miller, V.P.R.S. (with enclosure); J. Stubbins; Asher and Co.; T. Sterry Hunt, F.R.S. (with enclosure); J. Walker; W. H. Exall; C. R. A. Wright; W. Exmore; C. Richter; Professor Weltzein (with enclosure); Davenport & Co.; E. C. Hogg (with enclosure); E. P. H. Vaughan; Mottershead & Co.; J. C. Bell (with enclosure); Rudolf Schomberg (with enclosure).

Books Received.—"Boiler Deposits," by Dr. T. L. Phipson, F.C.S.; "Bulletin de la Société d'Encouragement;" "American Artisan;" "The Oriental Mail and War Office Gazette;" "American Journal of Mining: "Action of Sunlight on Glass," by Thomas Gaffield; "Scientific American."

Recent Improvements.—People do not as a rule take notice of the improvements and changes that take place in the small details of daily life—the changes from stage coaches to railways, the telegraph, the penny post, and many other great and startling novelties are all noticed and commented upon, and they each and all, more or less, impress us; but if we extend our observations, and recall the domestic appliances of a few years ago, and compare them with the present, we shall find plenty of subjects at any rate worthy of passing reflection. Take, by way of illustration, a common and every-day requirement—Candles—and refer to our advertisement columns, we shall be able to mark—within the experience of those not past the prime of life—great and startling changes. Thirty or forty years ago, wax and spermaceti candles lighted the upper ten thousand, and the masses accepted snuffer-requiring tallow candles as the only means of lighting open to them; now we advertise an almost bewildering variety of lights. Price's Patent Candle Company (which, under the name of Edward Price & Company, is the father of the candle trade), some thirty or forty years back, began by introducing cocoa-nut candles as a substitute for strong smelling tallow; then they invented composite candles, and to-day they advertise in our columns Belmontine, Price's Paraffine, Battersea Paraffine, Gold Medal Palmitine, Sherwood Palmitine, Belmont Wax and Belmont Sperm Candles, Best Composites, &c., &c. A good housekeeper is now bound to discriminate the advantages and prices among such an *embarras de richesses*, and our middle classes can now, at a reasonable price, be lighted as well as, or better than, princes were forty years ago.

An Introduction to Chemical Philosophy, according to Modern Theories, by ADOLPHE WURTZ, F.R.S.

Translated and Edited by WILLIAM CROOKES, F.R.S.

"A little work of singular merit, and appearing at a most opportune period; it gives a remarkably clear *expose* of the changes taking place in chemical nomenclature, with the reasons for their adoption."—Medical Times and Gazette.

London: J. H. Dutton, Chemical News Office, Boy Court
Ludgate Hill. E.C.

Scholl's Patent Platinum Gas Light Perfecter.—Extract from Report by Dr. Letheby:—
"The results have been very remarkable, for they show an average increase of 63 per cent on the illuminating power of the gas. I am of opinion, therefore, that the invention is of great practical value." Price One Shilling each for Fish-tail Burners. To be had retail of Gas-fitters and Ironmongers, and (wholesale only) of JOHN SCHOLL, 41 and 42, Berwick Street, Oxford Street, London, W. Terms on application. N.B.—A specimen sent free on receipt of 12 stamps.

PATENTS.

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TO PHARMACEUTICAL AND OTHER STUDENTS.

Mr. J. C. BRAITHWAITE, for thirteen years Principal Instructor in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c., wishes to inform his old Pupils and others that he continues to devote his whole attention to Education. The Session 1867—1868 will commence on the 1st of October, when

Mr. BRAITHWAITE'S Laboratory, which has been enlarged during the recess, will be re-opened at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

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The LATIN CLASS for the reading of the Pharmacopœia, Physicians' Prescriptions, &c., every Tuesday and Friday Evening, at 8 p.m., commencing October 1st.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday Evening, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will commence at 10 a.m., October 2nd.

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MEDAL PARIS EXHIBITION, 1867.

THE CHEMICAL NEWS.

Vol. XVII. No. 424.

ON THE
CHEMICAL GEOLOGY OF MR. DAVID FORBES.

By T. STERRY HUNT, F.R.S.

In the Chemical News of October 4th, 1867, there appears a paper purporting to be a criticism of some views on the chemistry of the primeval earth, put forward by me in a lecture delivered before the Royal Institution of Great Britain, on the 31st of May last, and published in the Proceedings of that Institution, as well as in the Chemical News of June 21st, and the *Revue des Cours Scientifiques*, of October 19th, and also in *Les Mondes* and *Cosmos*. The object of my present communication will be to notice briefly some of the criticisms of Mr. Forbes. The readers of my lecture are aware that I assumed as my starting point the hypothesis, now generally accepted, of the origin of our earth, and of all planetary and stellar worlds, by a process of condensation and cooling from a nebulous or a gaseous matter, so intensely heated as to be luminous, and to contain, at the same time, in a free or dissociated condition, the various chemical elements. The first objection of Mr. Forbes, is that I do not explain the origin of this intensely heated condition: a consideration entirely beyond the scope of my lecture, but established by the spectroscope, and to be accepted as an ultimate fact, the secret of which, like that of the origin of matter itself, rests with the Great First Cause.

In discussing the laws which presided over the cooling of our own globe, I gave several reasons which have led modern investigators to reject the old theory of a liquid centre covered by a thin crust of congealed rock. I alluded briefly to the mathematical deductions of the late Wm. Hopkins from the phenomena of precession and nutation,—those of Archdeacon Pratt on the feeble resistance which would be offered by a crust of the thickness generally admitted by the old school, to the crushing weight of masses like the Himmalayah Mountains,—and the conclusions of Thompson as to the rigidity of the earth, deduced from the theory of the tides, as so many concurrent arguments in favour of a crust at least many hundred miles in thickness, if not of a globe entirely solid. Proceeding, thence, to consider the conditions of cooling presented by the fused and oxidised mass of the globe, I asserted that the analogies offered by most of the bodies forming the earth's crust, which yield compounds considerably denser when solidified than when in their fused condition, lead us to conclude that the solidification of the globe must have begun from the centre. In fact, the numerous and detailed experiments of Charles Deville (*Comptes Rendus*, xx., 1453), and those of Delesse (*Bull. Soc. Geol. de Fr.* [2] iv., 1380), not to mention the earlier ones of Bischof, unite to show that the density of fused rocks is much less than that of the crystalline products resulting from their slow cooling, so that, as Saemann has justly observed, we are forced to conclude that the crystalline stony masses formed at the surface of a liquid globe must sink towards the centre (*Ibid*, Feb. 4, 1861). To this conclusion Mr. Forbes objects that, in the cooling of sulphur or metals from fusion, a crust forms at the surface before the interior is solidified; he should consider that the conditions in a small crucible, placed in a cold atmosphere, where cooling is rapid, and the crust is supported by adhesion at the edges, are vastly different from what would obtain in a world-wide bath, cooling with great slowness beneath an intensely heated atmosphere. In such a case, as the crystalline silicates known to us, are, according to numerous experiments, from one-seventh to one-sixteenth denser than the same materials in a fused condition, it would require a suspension of the laws of gravity to counteract the inevitable tendency of the heavier solids formed at the surface to sink in the fused mass, in which they would subside as naturally as the crystals which form at the surface of an evaporating basin of brine. The analogy holds good since the crystals formed at the surface, whether by evaporation or by cooling, obey the laws of gravity. The freezing over of the surface of such a mass would be as unnatural as the freezing of a lake of water from the bottom.

Mr. Forbes next comments upon my allusion to the experiments of Hopkins on the effect of pressure in elevating the melting points of such bodies as contract in cooling, and says that I appeal to these as conclusive proof that the melting points of bodies do become (*ad infinitum*) elevated in proportion to the pressure. In fact I said nothing of the sort, but insisted that the researches of Hopkins "are to be considered in this connection." If Mr. Forbes had taken some pains to inquire into the question, he would learn that these experiments of Hopkins, and others (by W. Thompson on the effect of pressure in reducing the melting point of ice) were suggested by a remarkable essay by James Thompson (Trans. Roy. Soc. Edin. xvi, part 5). In this it was shown that the fusing point of ice, which contracts in melting, must necessarily be reduced by pressure; while, as Sir Wm. Thompson showed, the reverse effect was to be expected for all solids which expand in melting (L. E. and D. Phil. Mag. [3] xxxvii. 125). The results of Hopkins thus come under a general physical law. Mr. Forbes will find a simple and intelligible statement of the principle laid down by Thompson, and Hopkins's argument therefrom, for the solidity of the interior of the globe, in the fourth of Dr. Tyndall's admirable lectures on Heat, delivered before the Royal Institution. See also Mr. Sorby's Bakerian Lecture for 1863. As to Mr. Forbes's suggestion of denser matters towards the earth's centre, I have said the same thing in my lecture.

Mr. Forbes next proceeds, in his own words, to submit my views of the chemical changes which took place at the surface of the globe, to "careful scrutiny," in order to determine whether "they are sound and likely to meet with acceptance in the chemical world." Of the critic's fitness for his self-imposed task the reader shall judge. The first thing to be determined in the cooling of an intensely heated vaporous mass is the nature of the chemical compounds which would be formed among the dissociated elements. As I have stated in my lecture, the combinations stable at the elevated temperature then prevailing, would be first formed. The affinities of oxygen are such, that under such conditions, an excess of this element being present, instead of sulphides of the heavy metals, as imagined by Mr. Forbes, oxides and sulphurous acid would be produced in virtue of affinities know to every chemist and metallurgist. So with regard to chlorine, the production of alkaline chlorides in such conditions is inconceivable, since in the conjoined presence of oxygen, hydrogen, and silica, an alkaline silicate and hydrochloric acid would necessarily result. Even if, as Mr. Forbes supposes, chloride of sodium were to be formed in the heated atmosphere, it would be precipitated into an intensely heated bath of fused silicates, covered by an atmosphere charged with aqueous vapour, or with mingled hydrogen and oxygen, and would immediately undergo the same decomposition that takes place when the vapours of common salt are diffused through the heated atmosphere of a potter's kiln, or, as in Mr. Gossage's new soda-process, are passed with steam over red-hot flints. In both cases silicates of soda are formed, with separation of hydrochloric acid. These considerations lead to the conclusion that, after all the more fixed elements were precipitated, the whole of the chlorine would remain as hydrochloric acid, and the whole of the sulphur as sulphurous acid, together with a large proportion of oxygen, since we find sulphates and not sulphites in the sea-waters. To this constitution of the still intensely heated atmosphere, Mr. Forbes objects, and inquires whether it is "at all probable, even if possible, that an excess of oxygen could exist along with the vast amount of sulphurous acid." He farther adds that "the improbability of such an atmosphere containing a mixture of hydrochloric and sulphurous acids, may be inferred from Dumas's researches; that chemist having long ago shown that these two gases, when mixed together, react and mutually decompose each other, with the formation of water, chlorine, and sulphur." Mr. Forbes thinks he has hit upon two objections to the existence of a heated atmosphere holding, as I have endeavoured to show, besides nitrogen, oxygen and watery vapour, sulphurous and hydrochloric acids. He has evidently a vague notion that sulphurous acid and oxygen have an affinity for each other, and ought to form together sulphuric acid. So they do unite slowly at proper temperatures, in the presence of water, being converted into oil of vitriol, and it was doubtless in this way, as I have elsewhere shown, that the sulphur was eventually brought down from the atmosphere, and formed the sulphates of the sea. But every chemist is aware that at higher temperatures oil of vitriol is resolved into water, sulphurous acid and oxygen gases, and that this reaction is made use of as an economical process for the preparation of oxygen on a large scale, the sulphurous acid being removed by absorption from the cooled gases. As regards his second point, Mr. Forbes, who cites Dumas (Traité i. 146) has been misled by quoting at second-hand, apparently from the English edition of Gmelin (ii. 321). Dumas states that in solution sulphurous acid and hydrochloric acid undergo no change; but, "in a dry state, on the contrary, they are rapidly decomposed, at least in operating over mercury." It may be true that as Gmelin states, water, chlorine, and sulphur result, but such is not the assertion of Dumas. The point, however, is immaterial, since as Dumas and Gmelin state, and as every chemist knows, the two gases remain unaltered in the presence of water, even if in the form of vapour. Indeed, it happens, unfortunately for both of Mr. Forbes's objections, that large quantities of precisely such an atmosphere as he supposes to be impossible, are disengaged from numerous volcanic vents, as he will find by referring to the researches of Charles Deville and Leblanc. (Ann. de Ch. et Phys. [3] lii. pp. 5—63). Among other examples described by these chemists, a *fumerolle* of Vesuvius yielded in June, 1856, a mixture of highly heated steam, hydrochloric acid and air, the latter containing in 100 parts, oxygen 18·7, sulphurous acid 2·6, the remainder being nitrogen; while the acids of the steam and air together yielded, for one part of sulphurous acid, about five parts of hydrochloric acid. Traces of sulphuric acid, due to the slow union of the sulphurous acid and oxygen, were found in the water condensed from this fumerolle. Volcanos, as I have elsewhere stated, reproduce, on a limited scale, the conditions of the primeval earth, not only in their solid but in their gaseous products.

Mr. Forbes proceeds to comment upon my illustration of the condition of the primitive globe from a supposed reaction of the present air, sea and land under the influence of intense heat. He suggests that the carbonaceous matters would convert into sulphides the mineral sulphates. Here, as before, he ignores the intervention of water and siliceous matters, which would cause the sulphur to escape in the form of sulphuretted hydrogen (which is doubtless evolved from modern volcanos by a similar reaction), and this at an elevated temperature, would at once be burned to sulphurous acid and water. He descends to trifling when he objects that by the effect of heat upon the present surface of the globe, the water of the sea would be first evaporated, and then the chloride of sodium sublimed in its turn. It was made clear to every reader, that I never intended by this illustration to represent the process of nature; moreover, I said, "*if the elements were made to react upon each other*," which would not be the case if they were successively removed by evaporation beyond the sphere of reactions.

Here I cannot resist the temptation of giving my readers a choice specimen of Mr. Forbes's chemistry, which he has embodied, with many other surprising things, in a further criticism of my lecture, which appears in the *Geological Magazine* for October, but has, for some unknown reason, withheld from the readers of the Chemical News. Proceeding to give his own notions of the chemistry of the primitive globe, Mr. F. supposes that immediately above the "solidified crust," there existed a zone composed chiefly of chloride of sodium; "above this, a stratum of carbonic acid, and then of water in the form of steam, whilst the oxygen and nitrogen would be elevated still higher;" and, probably, also, in Mr. F.'s imagination, separated according to their densities. In explanation of this order, he tells us, in a note, that the zone of carbonic acid gas would be heavier than that of steam, and should therefore come below it; he even gives their respective weights, but he forgets that oxygen and nitrogen are also both heavier than steam, and should be found below, and not above, this zone of watery vapour. In fact, as is well known, the specific gravity of oxygen being 1·109, and nitrogen, 0·970, that of atmospheric air is 1·000; while carbonic acid gas is 1·525, and that of watery vapour, 0·624. But, apart from this absurd mistake, what shall we say of the man who displays an utter ignorance of the laws which govern the diffusion of gases and vapours? Will Mr. Forbes explain why it happens that in our present atmosphere, these same elements, namely, oxygen, nitrogen, carbonic acid gas, and watery vapour, are commingled, instead of being, as he would have them, arranged in separate zones?

Mr. F.'s mode of explaining the saltness of the sea must fall to the ground, unless he succeeds in showing how, despite well known chemical affinities, the requisite amount of chloride of sodium could be formed and preserved under the conditions which I have discussed above, so that, as he supposes, it was ready to be dissolved by the first waters precipitated on the surface. When he has satisfactorily established this part of his theory, he will, perhaps, tell us how sulphates found their way into the sea, if, as he asserts, all the sulphur was at first separated in the form of dense metallic sulphides, which sank at once, "and remained in the interior of the earth, protected from oxidising action?" Mr. F. may have data unknown to the world, for estimating the total amount of sulphur in the globe; but when he tells us that it would be sufficient to convert all the soda of the sea to sulphate, he reasons as if the amount of bases in nature were limited, forgetting that the earth's crust contained more than enough of alkalies, lime, and magnesia, to saturate the acids of the primeval atmosphere, and, moreover, that the whole of the sulphur, sulphates, and sulphides of the earth's crust, have, to judge from all analogy, been derived from the soluble sulphates of the ocean.

Mr. F. next proceeds to enquire why the sea contains so much sodium, and so little potassium? If he will study the question, as he may do in my *Contributions to the Chemistry of Natural Waters* (Amer. Jour. Sci. [2] xxxix. 176; xl. 43, 193.), he will learn that at an early period the salts of calcium and magnesium greatly predominated over those of the alkalies in the ocean waters, precisely as they must have done in the crust of the primitive earth. It is by subsequent subaerial decomposition that have been liberated the alkalies, which, in the form of carbonates, have decomposed the salts of the primitive sea, and substituted sodium for calcium, for it is well known that natural alkaline waters convey to the sea chiefly soda, and comparatively little potash, which is retained by argillaceous sediments. Moreover, the potash which does find its way to the sea, is constantly withdrawn in the form of glauconite, and also by the agency of fucoids, which, as Forchammer has shown, fix great amounts of potash, and, subsequently, by their decay in the ooze, restore it to the earth.

Mr. Forbes next expresses surprise that I find the origin of all carbonate of lime (except that from the subærial decomposition of primitive calcareous silicates) in the reaction of carbonate of soda on the lime-salts of sea-water, since, according to him, the results of the careful study of limestone rocks by geologists, palæontologists and microscopists have shown these rocks to be "*the result of organic action.*" And, moreover, that neither chemists nor zoologists will accept my assertion that *animals can only appropriate the carbonate of lime which they find ready formed*, but "will consider these animals capable of utilising the other lime-salts in the sea." If we admit the power of the lower animals to decompose chloride of calcium or sulphate of lime, as would appear from the acid liquid said to be found in some of them, will Mr. Forbes tell us what becomes of this at the death of these animals, and how the acid is to be disposed of? If the thousands of feet of limestone strata, consisting in large part of organic remains, have been derived from the decomposition of the sulphate or chloride of calcium of the sea by any other process than by that which I have indicated, namely, the intervention of alkaline carbonates, will Mr. Forbes kindly inform us what has become of the vast amount of hydrochloric acid equivalent to all this carbonate of lime?

As to the origin of dolomites Mr. Forbes will do well to read my paper in the *Amer. Jour. Science*, for July, 1866 ([2] xlii, 49). In this, at § 112, he will see that apart from the formation of stratified sedimentary dolomites, I insist upon the frequent occurrence of dolomite as a mineral of secondary deposition, lining drusy cavities, filling veins, and even the moulds of fossil shells. To such cases, the observations of Sorby and of Harkness may probably be referred; the microscopical investigations of the former, as given by him in the British Association Report for 1856, are like all the other works of that excellent observer, doubtless entitled to the highest credit. No one, however, who has carefully studied, as I have done, the distribution and association of the great beds of dolomite which occur in the Lower Silurian rocks of Canada and New England, can, for a moment, admit that they are the products of subsequent alteration. Repeated alternations of pure blue lime-stones with reddish ferruginous dolomites, interrupted beds and patches of these enclosed in the former, the line of demarcation sharply drawn, and finally conglomerates in which pure limestone pebbles are enclosed in beds of dolomite, all of which may be studied near Quebec, are evidences incontrovertible against the theory of dolomitization of pure lime-stones, and in favour of the deposition of dolomites as magnesian sediments.

Mr. Forbes insinuates that I am unaware of the various speculations and theories which have been put forward to explain the supposed origin of dolomites by alteration. Although the stratigraphical relations of dolomites, as described above, set aside entirely this hypothesis of its formation, at least in the great majority of cases, Mr. Forbes will find that the observations and speculations of Haidinger, Von Morlot, Marignac, and others on this subject, have been discussed and made the subject of multiplied experiments by me in a memoir published in 1859 (*Amer. Jour. Sci.* [2] xxviii. 170, 365), and farther in the paper quoted above; and that I have shown that the reaction of the sulphate of magnesia on carbonate of lime, to which he refers, does not give rise to dolomite, but to an admixture of the carbonates of lime and magnesia.

Some of the results of my prolonged study of certain salts of lime and magnesia, which are for the most part set forth in the papers just referred to, were, says Mr. Forbes, by me considered worthy of being presented to the French Academy of Sciences (*Comptes Rendus*, April 22, 1867), although he declares the reactions there described to have been for twenty-five years in general application on a large scale in Great Britain, for the manufacture of magnesian salts. Here it becomes difficult to admit the plea of ignorance which suggests itself for most of Mr. Forbes's previous statements. I have in the note to the French Academy above referred to, pointed out the following as facts discovered by my investigations of the salts of lime and magnesia: 1st. That bi-carbonate of lime, at ordinary temperatures, decomposes solutions of sulphate of soda and sulphate of magnesia, with formation of sulphate of lime and bi-carbonates. 2nd. That from mingled solutions of sulphate of magnesia and bi-carbonate of lime, there separates, by evaporation, crystalline gypsum, and subsequently a hydrous carbonate of magnesia; the bi-carbonate of this base being, as is well known, very much more soluble than the sulphate or the bi-carbonate of lime. 3rd. That this separation of gypsum is favoured and rendered more complete by an atmosphere impregnated with carbonic acid gas; and 4th. That mixtures, in due proportions, of precipitated carbonate of lime and hydrous carbonate of magnesia, when gently heated under pressure, and in the presence of water, unite to form the anhydrous double carbonate, dolomite. These are the reactions which I described to the French Academy as *new*, and I demand Mr. Forbes to make good his assertion to the contrary, or to show that any one of them has been employed for the last twenty-five years in the manufacture of magnesian salts.

Montreal, December, 1867.

ON

HEAT AND COLD;

A COURSE OF

SIX LECTURES*

(*Adapted to a Juvenile auditory*),

DELIVERED AT

THE ROYAL INSTITUTION OF GREAT BRITAIN,

(*CHRISTMAS*, 1867–8),

BY

JOHN TYNDALL, Esq., LL.D., F.R.S.

Lecture III.

Winds and breezes—Ice, snow, and glaciers.

In the last lecture I showed you the change which takes place in water when it is gradually cooled; and I showed you in a very striking manner that water when it freezes and becomes ice, expands, and that the force of the expansion is so great as to burst the bombshell which was placed before you in the last lecture. Now follow me for a moment, please. Conceive water at the ordinary temperature; conceive it growing gradually colder and colder. Like almost all other bodies it becomes smaller and smaller; it shrinks as it becomes colder; but at a certain point, and some time before it turns into ice, it leaves off contracting. Suppose the water to go down from a temperature of 60°: it continues contracting until it reaches the temperature of 39° Fahr., or 4° Centigrade; and then the water instantly ceases to contract, and 7° F. before it becomes solid it begins to expand as it becomes colder. What is the consequence of this expansion? The water from 39° Fahr. downwards, becomes lighter, and it swims like oil over the surface of the water underneath, and there it is frozen; and when it freezes—when it passes from the liqdid state to the solid state—a sudden and very great expansion occurs, so that eight volumes of water weigh about as much as nine volumes of ice, the ice being the lighter of the two, and therefore swimming upon the water.

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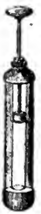
* Reported verbatim, by permission of the Author, for this journal.

I must ask you now to accompany me for a moment to some of the things that occur in nature in connection with this subject of heat. You know that at certain parts of the earth's surface the heat is very much more powerful than it is here in England; and you know that the reason of this is that at certain parts of the earth's surface the sun is overhead, and its rays come vertically downwards, and thus heat very much the surface of the earth directly underneath the sun. In the region of what is called the Equator we know that the sun is directly above the heads of the people living there and at a certain distance on each side of it. Now, imagine this sun pouring down its heat through the atmosphere upon the sea. The surface of the sea is thereby warmed, a quantity of vapour is produced, and that vapour ascends with the air into the higher regions. When the surface of the earth at the equator is heated, the air also at that point becomes heated, and rises, as the air of this room rose from the surface of that heated spatula, in the last lecture. When the air at the Equator is heated by the sun, part of it goes towards the North Pole and part towards the South Pole, while underneath air rushes in from the other directions to supply the place of the air which goes to the north and south. If you could see the air you would see it going one way and coming back another. A continuous circulation is thus going on, and the winds that are produced in this way have a particular name given them. They are called the "trade winds." The current above is called the "upper trade wind," and the current beneath is called the "lower trade wind." Now, as I have said, when the sun's rays act upon the ocean they convert its water into vapour, and this vapour is carried up into the air. What is the consequence? I want to show you one or two facts that will enable you to understand what must occur.

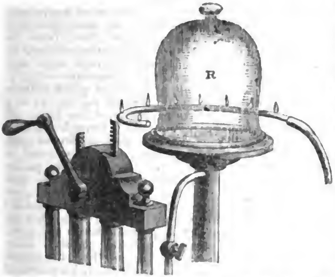


The first fact that I wish to show you is that if we compress air suddenly we develope heat; and I do this by means of the syringe that I have here. This is a small (Fig. 1.) glass tube bored very carefully, and furnished with a piston that fits air-tight into that glass tube; so that if I squeeze this piston down I compress the air underneath it. Now, here I have a piece of German tinder which I place in a little cavity made at the bottom of the piston; and I think I shall be able to ignite that German tinder by forcing down the piston and thus compressing the air. [The tinder was ignited as described.] Now, what we have done here is, indeed, nothing more than simply throwing the atoms (as we have agreed to call them) of the air into this intense state of vibration to which we give the name of heat. On the other hand, if we take a body having a certain amount of heat, and, instead of compressing the air, allow it to expand, then the expansion of the air produces cold. I will show you one effect of this expansion of air. I have here condensed in this vessel—forced in by a kind of syringe—a great deal more air than the vessel would contain naturally; and if I were simply to turn this cock and allow the air to issue from the vessel against an air thermometer, I should produce an effect which would, perhaps, be visible to my young friends immediately before me. If cold is produced in this way the column will rise a little. I will now turn this air out against the thermometer. The column has risen a little, which proves that the air which has come out of this vessel, and become expanded, has become chilled. A great man who used to lecture in this room many years ago—Sir Humphry Davy—described a machine which he saw at Schemnitz in Hungary, formed so as to allow a very strong current of compressed air to issue from it, and the amount of cold produced by the expansion of the air was such as to cause the vapour of the atmosphere to condense and congeal and form icicles. Now, I want you to remember that when air is condensed in the way I have described heat is developed, and that when an expansion of the air takes place an opposite effect is produced. Mr. Cottrell has here arranged a little experiment, but as I do not know whether it will be visible or not to you all, I will tell you what it is. This glass receiver contains air, and within is a small elastic balloon which also contains air. The air which the balloon has within it has a certain amount of heat, and in virtue of that heat it has a certain power of squeezing out the sides of the balloon. If we now pump the air out of the outer vessel, and so remove the air from the outside of the balloon, we take away the force which counteracts the force inside this balloon. It will then expand and almost fill the entire vessel. [The air was then exhausted by means of an air pump.] You see the balloon becomes larger and larger. You see it growing visibly before you, and the air within this balloon at the present time is being chilled because of its expansion. The assistant will go on pumping out the air from the glass receiver, and after a time the balloon will almost fill the receiver. It thus goes on swelling and swelling, the air within it expanding, and this air, by the act of expansion, becomes chilled. We will now allow the air to enter by turning this cock, and then the balloon will shrink to its first dimensions. See how small it becomes, because we get a pressure on the outside of the balloon squeezing it inwards, until now it is finally reduced to the same size that it had at the commencement. Mr. Cottrell will now remove that balloon altogether, as I want to show you what takes place within that receiver when the air is thus taken out of it. I want to show you the effect of the chilling produced by the rarefaction or expansion of the air in nature. But first I will tell you the effect produced on a body of air rising, we will say, from the surface of the sea to a certain height above it. We will take a definite height, such as we often find in the Alps—11,000 feet, the height of one of the higher Alpine passes. Conceive, then, a body of air rushing up the mountain, and going to the top of that pass. In climbing up this 11,000 feet the air gets into a place where it is not so much pressed upon as it was below. A portion of the atmosphere has been removed from above it, and the consequence is that the rising air expands, and the expansion is followed by a lowering of its temperature. The air becomes colder, and if it had in it as much moisture as it could hold, it would, in rising 11,000 feet, fall very nearly 40° Fahrenheit in temperature.

Now, you must remember that in order to preserve the vapour of this room in an an invisible state, a certain temperature is necessary. If you could at this moment introduce into this room the temperature of the polar regions, what would you obtain? First, the air of the room would thicken so as to form a fog, and then that fog would be chilled and fall as snow. This has occurred over and over again in Russia and elsewhere. So if you could only get the temperature of this room low enough you would see the now invisible aqueous vapour falling as snow. Even in London ball-rooms this may sometimes be observed. When the windows have been opened in the intervals of the dances the air has immediately become cooled, and a condensation of the vapour has taken place sufficient to make the atmosphere dim. Now imagine air charged with invisible vapour being carried up one of these high Alpine passes. If in this way it gets its temperature reduced to 32°, the air can no longer hold its vapour, that vapour then falls as snow, and that snow is deposited on the tops of the mountains.

I want now to show you how clouds are formed by the condensation of vapour. Here we have the receiver of our air-pump, enclosing a quantity of air which is charged with invisible aqueous vapour. Mr. Chapman will now place a lamp behind this glass receiver. I will send a beam of light through the receiver, and let it fall on the screen. At first you will not see any appearance of anything inside the receiver. I will then ask Mr. Cottrell to work the air-pump, and exhaust some of the air, and thus cause the remaining air to expand. This will reduce its temperature, and then you will see that the vapour within the receiver will become a fog. You now see no sign of any thing within the receiver; but we will now exhaust the air. [The air-pump was then put in action, and a condensation of the vapour became immediately manifest.]

Fig. 2.



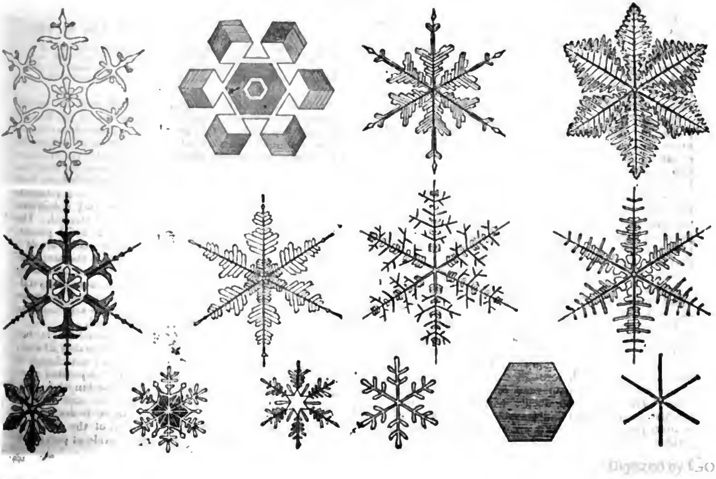
You see a cloud has now formed in the receiver, and when the air is allowed to re-enter, it causes the cloud to go entirely away, although the vapour itself is still there. We will work the pump again, and you will see that the cloud is again formed, and will be again illuminated by the light from the lamp. There it is. That is a true cloud which is formed in this way from the air of the room, and it is in this way that clouds are formed in the atmosphere by the expansion and consequent cooling of the air which rises from the surface of the sea.

These clouds may fall as rain, but as I have said, they may also fall as snow. I suppose that snow is such a familiar thing to every boy and girl here present, that it may seem to be hardly worth thinking about; but still this substance is one of the most wonderful and beautiful things in the whole world; and when snow is formed in a very still atmosphere, as I have often had the pleasure of seeing it formed in the Alps, it takes the form of those beautiful figures which are represented in the diagram yonder. (Fig. 3.)

It forms as small six-rayed stars. This is the form of the snow which goes on loading the Alpine mountains year after year; and when we look at these mountains and at the valleys connected with them, we find that the most wonderful series of appearances presents itself. On very closely observing the snow upon the Alpine slopes we find that it is in a state of motion. We find that the snow has been incessantly moving down the Alpine slopes into the valleys; and hence we have the valleys filled with rivers of ice. On standing for the first time beside one of these rivers of ice you would imagine that it was perfectly motionless, and that a body so rigid as ice could not move at all; but when you make proper observations, you find that the ice is perpetually moving down, and thus we have these glaciers of the Alps. I have no doubt that every boy here will one day visit those glaciers for himself. I have here a sketch of one of the most famous of those glaciers. It is called the "Mer de Glace," and is situated near Chamounix. This Mer de Glace has its great feeders from the snows that fall upon Mont Blanc and the series of mountains which are rudely sketched in this diagram. Here is a great cascade where the snow, after being half consolidated—squeezed together so as to form ice—actually moves down, forming a cascade of ice which comes along this valley. Here is another basin where the snows collect, and where its particles are squeezed into ice, and you have this ice also always in a state of motion.

Now let us look at the lines which I have drawn on the diagram. The mountains beside the glaciers are always sending down stones and dirt, and consequently you

Fig. 3.



always have lines of dirt carried down; and you see that where two glaciers have their sides turning and uniting as here shown, they form a line along the middle of the trunk of the glacier. Now, these lines which I have mentioned are called *moraines*. Those at the side are called *lateral moraines*, and those in the middle are called *medial moraines*. We have in the Mer de Glace these three moraines. If we examine this glacier we find that notwithstanding the rigidity of ice it moves down like a river. Eminent men have worked at this subject; Saussure worked at it a little—not much, and was followed by Bordier, who observed that ice behaved almost like a viscous body. He was the first to propound the fact that ice was of this character. He was followed by Rendu, who also took up the idea that ice behaved like a viscous body such as honey, or treacle, or tar, or paste. Then he was followed by Mr. Agassiz and another, and they determined the velocity with which this ice falls. Then came Principal Forbes, an eminent Scotchman, and his measurements pushed the question far beyond its former stage. And then came Mr. Huxley and myself; and we pushed the matter a little forward; and afterwards I did a little on my own account in reference to this question. It is in this way that scientific knowledge is accumulated. It goes rolling on and becoming bigger like a snow-ball, and thus it is that science grows and has grown to what it is at the present day.

(To be continued.)

ON THE

IDENTITY OF THE BODY IN THE ATMOSPHERE WHICH DECOMPOSES IODIDE OF POTASSIUM, WITH OZONE.

By THOMAS ANDREWS, M.D., F.R.S.

It was assumed for many years, chiefly on the authority of Schœnbein, that the body in the atmosphere which colours iodide of potassium paper is identical with ozone; but this identity has of late been called in question, and as the subject is one of considerable importance, I submitted it lately to a careful investigation, the results of which I beg to lay briefly before the Society. The only property of ozone, hitherto recognised as belonging to the body in the atmosphere, is that of setting free the iodine in iodide of potassium; but as other substances, such as nitric acid and chlorine, which may possibly exist in the atmosphere, have the same property, no certain conclusion could be drawn from this fact alone.

One of the most striking properties of ozone is its power of oxidising mercury, and few experiments are more striking than that of allowing some bubbles of electrolytic oxygen to play over the surface of one or two pounds of mercury. The metal instantly loses its lustre, its mobility, and its convexity of surface, and when moved about it adheres in thin mirror-like films to the sides of the containing glass vessel. The body in the atmosphere acts in the same way upon pure mercury; but from the very minute quantity of it which is at any time present, the experiment requires some care in order that the effect may be observed. On passing a stream of atmospheric air, which gave the usual reaction with test-paper, for some hours over the surface of mercury in a U-tube, the metal was distinctly oxidised at the end at which the air first came into contact with it.

This experiment, however, cannot be considered conclusive, as mercury will tarnish and lose its mobility under the influence of many bodies besides ozone.

It is well known that all ozone reactions disappear when ozone is passed through a tube containing pellets of dry peroxide of manganese, or other body of the same class. The same thing occurs with the substance supposed to be ozone in the atmosphere. About eighty litres of atmospheric air were drawn, at a uniform rate, through a tube containing peroxide of manganese, and afterwards made to play upon very delicate test-paper. Not the slighest coloration occurred, although the same paper was distinctly affected when ten litres of the same air, without the interposition of the manganese tube, were passed over it.

But the action of heat furnishes the most unequivocal proof of the identity of the body in the atmosphere with ozone. In a former communication (*Phil. Trans.* for 1856, p. 12). I showed that ozone, whether obtained by electrolysis or by the action of the electrical brush upon oxygen, is quickly destroyed at the temperature of 237° C. An apparatus was fitted up, by means of which a stream of atmospheric air could be heated to 260° C. in a globular glass vessel of the capacity of five litres. On leaving this vessel, the air was passed through a U-tube, one metre in length, whose sides were moistened internally with water, while the tube itself was cooled by being immersed in a vessel of cold water. On passing atmospheric air in a favourable state through this apparatus, at the rate of three litres per minute, the test-paper was distinctly tinged in two or three minutes, provided no heat was applied to the glass globe. But when the temperature of the air, as it passed through the globe, was maintained at 260° C., not the slightest action occurred upon the test-paper, however long the current continued to pass. Similar experiments, with an artificial atmosphere of ozone, that is, with the air of a large chamber containing a small quantity of electrolytic ozone, gave precisely the same results. On the other hand, when small quantities of chlorine or nitric acid vapour, largely diluted with air, were drawn through the same apparatus, the test-paper was equally affected, whether the glass globe was heated or not.

From these experiments I consider myself justified in concluding that the body in the atmosphere, which decomposes iodide of potassium, is identical with ozone.—*Proceedings of the Royal Society.*

FOREIGN SCIENCE.

PARIS, JAN. 14, 1868.

Double sulphocyanides of chromium—Ozone and antozone—Experimental demonstration. ACADEMY OF SCIENCES.—The mineral Woodwardite—Electrolysis of tartaric acid—Passage of electric currents through incandescent gases—Reestablishment of the voltaic arc.

An extended series of compounds, which may be termed chromosulphocyanides, has been obtained by M. Rœsler. This chemist finds, in the first place, that when concentrated solutions of 6 parts of sulphocyanide of potassium and 5 parts of chrome alum are mixed, the violet colour gradually passes to a wine red; heat quickens the reaction. The solution filtered from the sulphates which have been precipitated by alcohol, and evaporated just to crystallisation, yields sulphocyanide of chromium and potassium. It may be purified by recrystallisation from alcohol. The salt crystallises in deep coloured quadrilateral prisms, almost black; seen by transparent light, they are of a ruby-red colour. They are not altered by the air; submitted to heat they become very dark coloured, but during cooling take a fine red tint. At 110° the water of crystallisation is driven off, the salt becoming opaque; at a more elevated temperature it is decomposed. This salt dissolves in ·72 parts of water and ·94 parts of alcohol.

Sulphocyanide of chromium and potassium is not affected by sulphide of ammonium nor carbonated alkalies, even upon boiling. A dilute solution does not change in the cold, but sesquioxide of chromium is deposited upon heating. Ammonia only destroys the combination after prolonged ebullition. Weak hydrochloric acid has no action in the cold, but upon heating there is decomposition. When to a concentrated solution of the salt, concentrated hydrochloric acid is added, chloride of potassium is separated, a yellow powder adhering which contains much sulphur; this pulverulent matter appears to be persulphocyanic acid. When the potassium salt is evaporated with hydrochloric acid, there is complete decomposition, with formation of chlorides of chromium and potassium.

Sulphocyanide of chromium and potassium does not precipitate the solutions of the alkaline earths, nor those of cadmium, cobalt, nickel, zinc, manganese, and iron. With sulphate of copper the red colour passes into violet blue. After the lapse of some time, oxide of copper is deposited. If heated, it is formed more rapidly.

Mercuric salts cause a voluminous red precipitate which collects upon ebullition; it dissolves but little in nitric acid. Mercurous salts give a yellow precipitate, changing into greenish brown; nitric acid oxidises this compound to the red one described above. The salts of tin slowly give rise to a white precipitate. The sulphocyanide of chromium and ammonium has been formed. It resembles the preceding compound crystallographically and chemically. It is prepared in a similar manner. Sulphocyanide of chromium and sodium is obtained by dissolving oxide of chromium in sulphuric acid and adding sulphocyanide of sodium. The mixture is boiled for some time, and on cooling, the sulphates are deposited. Alcohol is added, which dissolves the double sulphocyanide. The salt crystallises in small plates; it is deliquescent. In an atmosphere dried by sulphuric acid it loses water and falls to a powder of a clear red colour. At 110° the water of crystallisation is driven off, no further alteration being induced at this temperature. With reagents it manifests less stability than the salts already described. Sulphocyanide of chromium and barium is obtained by dissolving oxide of chromium in hydrochloric acid, removing the excess of hydrochloric acid by evaporation, and decomposing with sulphocyanide of barium. It is separated from chloride of barium by crystallisation. This salt crystallises in short four-sided prisms; it is deliquescent.

The barium salt furnishes double sulphocyanides by decomposition with the sulphates. A number of other metallic sulphocyanides have also been combined with sulphocyanide of chromium. The sulphocyanides of silver, lead, and zinc have been combined in this way.

All attempts to separate chromo-sulphocyanic acid failed; but M. Rœsler has found that in the decomposition of a solution of the lead or silver salt by sulphuretted hydrogen, an acid liquid of a deep red colour is obtained, which he thinks undoubtedly contains the acid.

An experiment of M. Schönbein's, illustrating the simultaneous formation of ozone and antozone, is said to be the following:—Into a flask of 500 c.c. capacity, and 3 or 4 centimetres in diameter across the neck, a little ether is poured, just enough to cover the bottom, and a spiral of red hot platinum is plunged into the vapours. It is necessary to avoid heating the flask too strongly. The platinum glows until all the ether has been destroyed. The experiment is repeated two or three times, and now the question is to demonstrate that both ozone and antozone are formed in this slow oxidation of the ether. The first is, of course, easily shown to be present by means of the iodide of potassium and starch paper. To show the presence of antozone the flask is rinsed with a small quantity of ether, which will then be sufficiently charged with peroxide of hydrogen to give clearly the perchromic acid reaction. Some solution of bichromate of potash is placed in a test tube, and a drop of sulphuric acid added, the ether with which the flask has been rinsed is then poured in, when the etherial layer becomes coloured a beautiful violet blue. The conclusion to be arrived at from this experiment is that during the formation of ozone, antozone is also formed,—this in the presence of water, being converted into peroxide of hydrogen.

The memoirs relating to chemistry and physics brought before the Academy of Sciences on the 30th of December, were the following:—"On the Woodwardite of Cornwall," by M. Pisani; "Electrolysis of Tartaric Acid," by M. Bourgoin; "On the Passage of Electric Currents through Incandescent Gases," by M. Becquerel; and "The Spontaneous re-Establishment of the Voltaic Arc after an Extinction of Short Duration," by M. Le Roux. M. Pisani commenced by referring to the description given by Mr. Church of this mineral, and compared an analysis by this chemist with his own; the numbers only differed in one constituent, viz., the alumina, which in his specimen was less and which contained silica; this latter, however, was in insufficient quantity to constitute a silicate with the alumina.

He also gave an analysis of a Cornish mineral resembling Woodwardite. These are the percentage results:—Oxide of copper, 17·4; sulphuric acid, 4·7; alumina, 33·8; silica, 6·7; water, 38·7. The greatest difference, as shown by the analysis between this mineral and Woodwardite is in the alumina. M. Pisani observed that the mineral might be considered as a mixture of Langite with a very basic silicate of alumina analogous to Scarbroïte or to Schrœtterite, or as a mixture of Langite with a hydrate of alumina and mixed with a silicate of the allophane species. He does not imagine Woodwardite to be a new species of mineral, it may be considered as composed of a mixture similar to the new mineral just described.

M. Bourgoin's memoir is a continuation of his research on the electrolysis of organic acids. He has studied the action of the current upon neutral tartrate, on a mixture of tartrate and alkali, lastly, on free tartaric acid. To examine the fundamental action of the current on tartaric acid, a concentrated solution of the neutral tartrate of potash is conveniently operated upon. As soon as the current passes, the solution becomes alkaline at the negative pole; only a moderate disengagement of gas is produced at the two poles. The principal result is the formation of a white precipitate, which is slowly but continuously deposited from the positive electrode. Analysis shows this substance to be wholly cream of tartar. The solution at the positive pole remains neutral during the experiment. The gas evolved at the positive pole was composed of carbonic acid, oxygen, carbonic oxide, and nitrogen. Nearly the whole of the loss takes place at the positive pole. M. Bourgoin gives the following equation as expressing the fundamental action—

$$C_8H_4K_2O_{12} = (C_8H_4O_{10} + O_2) + K_2;$$

this secondary reaction follows—

$$C_8H_4O_{10} + H_2O_2 = C_8H_6O_{12}.$$

The tartaric acid thus regenerated at the positive pole forms with the neutral tartrate, cream of tartar; there is, however, some tartaric acid destroyed by oxidation. The action of the current on a mixture of neutral tartrate and alkali produces quite different results to those obtained with neutral tartrate only, notwithstanding that the fundamental action is the same. At the positive pole a mixture of carbonic acid, carbonic oxide, oxygen and hydride of ethylen is evolved. M. Berthelot discovered acetylen also in a sample of the gas sent him by M. Bourgoin. The decomposition of free tartaric acid yielded the same products as the neutral tartrate, though in different proportions. The carbonic acid is the dominant product from the first; the carbonic oxide diminishes as the experiment proceeds; the same is the case with the oxygen and nitrogen, though to a less extent. Acetic acid is formed at the positive pole. After the fifth day the experiment had been in progress, the solution in the neighbourhood of the positive pole contained a large quantity of acetic acid, which was isolated as acetate of baryta. The following equations explain the action of the current upon free tartaric acid: the fundamental reaction taking place is $C_8H_6O_{12} = (C_8H_4O_{10} + O_2) + H_2$, followed by the secondary reaction—

$$C_8H_4O_{10} + O_2 = 2C_2O_4 + C_4H_4O_4.$$

M. Becquerel's paper referred to one recently contributed by M. Bouchotte, who has observed that by the introduction of a voltameter of acidulated water in the circuit developed by a magneto-electric apparatus, producing two series of alternating currents, these may be made to give place to one series, or to currents of only one kind. M. Becquerel devoted himself chiefly to the explanation of the phenomenon.

M. Le Roux finds that results in regard to the establishment of the voltaic arc, similar to those given by induction currents, may be obtained with the ordinary currents from voltaic piles. With a nitric acid battety of 50 elements, the current may be interrupted for a time which may extend to about $\frac{1}{50}$th of a second, and then leap from one carbon to the other, although they be three millimètres apart.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Glycogen.—The amyloidical matter found in mollusks is, according to Bizio, glycogen. If the latter, after precipitation with alcohol, is allowed to dry gradually, it coheres together in lumps. Rapid desiccation leaves it as a fine powder, in which condition glycogen has commonly been observed. In contact with white of egg or casein, lactic acid fermentation slowly sets in. Dried at 100° C., its composition is $C_5H_{10}O_5$.—(*Comptes R.* lxv. 175).

Monamines derived from Aldehydes.—H. Schiff. Prolonged action of alcoholic ammonia upon acetic aldehyde, at ordinary temperature, gives rise to the formation of two bases—C_6H_9N or C_6H_7N (Picolin), distilling at 60°—70° C., soluble in water, and $N_2(C_2H_4)_3$ remaining in the residue after distillation. The latter (which has not been obtained pure) is decomposed by water and acids with formation of another soluble base—$C_6H_{11}NO$. The derivation of this third, a tertiary monamine from aldehyde-ammonia, is explained by the following equation :—

$$N\left\{\begin{matrix}C_2H_4,OH\\H_2\end{matrix}\right. + 2C_2H_4O = 2H_2O + N\left\{\begin{matrix}C_2H_4.OH\\(C_2H_3)_2\end{matrix}\right.$$

When aldehyde is treated with ammonia at 100°, two other bases are obtained—$C_{10}H_{15}NO$, and $C_8H_{13}NO$, of which the latter has already been noticed by Heintz and by Wislicenus. Hydro-œnanthamide $N(C_7H_{12})_3$ is decomposed by boiling water, and the compound

$$N(C_7H_{13})_2(C_7H_{14},OH)$$

formed, which shows no basic properties.

Related to these are valeral-ammonia and Erdmann's trioxyamylidene, to which the formulæ

$$N\left\{\begin{matrix}C_5H_{10},OH\\H_2\end{matrix}\right.$$

and $N(C_5H_{10},OH)_3$ are given.

The reaction between acrolein and ammonia is somewhat different, inasmuch as first a combination of the two in equivalent proportions takes place, which then acts on an excess of acrolein, thus :—

$$2N\left\{\begin{matrix}C_3H_4,OH\\H_2\end{matrix}\right. + 2C_3H_4O = 2H_2O + N_2\left\{\begin{matrix}2(C_3H_4.OH)'\\2(C_3H_4)''\end{matrix}\right.$$

This base resembles closely those derived from acetic aldehyde. Ammonic sulphhydrate converts acrolein and œnanthol into acrothialdin $C_9H_{13}NS_2$, and œnanthothialdin $C_{21}H_{43}NS_2$.

From the reactions of these bodies the author concludes that the thialdines likewise are tertiary amines, in which three typical hydrogens are replaced by three radicals containing the sulphur, as sulphydril (SH), just as the bases above mentioned contain oxhydril (OH).—(*Comptes R.*, lxv. 320.)

Influence of Coloured Light on the Decomposition of Carbonic Anhydride by Plants.—L. Cailletet. The red and yellow rays of light are the most favourable in promoting the decomposition of carbonic anhydride by plants. Light which passed through a solution of iodine in carbonic disulphide prevents decomposition altogether. Under the influence of green light, not only does no decomposition take place, but new quantities of carbonic anhydride are formed. A fresh leaf exposed to sunlight, under a bell-jar of green glass, exhales nearly as much carbonic anhydride as it would in the dark.—(*Comptes R.* lxv. 322.)

Synthesis of Diethylated Toluol.—Lippmann and Longuinine. With a view of arriving at a clearer conception of the constitution of the radical amyl, and of finding a new method for the synthesis of aromatic hydrocarbons, the authors investigated the action of zincic ethide upon chlorobenzol (chloride of oil of bitter almonds). The reaction that takes place is the following—

$$C_6H_5,CHCl_2 + Zn(C_2H_5)_2 = C_6H_5,\\CH(C_2H_5)_2 + ZnCl_2$$

The hydrocarbon $C_{11}H_{16}$ must be considered as toluol in which 2 atoms of hydrogen of methyle are replaced by 2 of ethyl. Its density was found = 5·1107, calculated = 5·1245. Its boiling point when pure, is at about 180° C. or 15° lower than that of Fittig's amylbenzol, which has the same composition. It follows from this that the two are differently constituted, and that the formula of amyl is not correctly represented as—

$$C\left\{\begin{matrix}(C_2H_5)_2\\H\end{matrix}\right.$$

(*Comptes R.* lxv., 349.)

Succinic Acid from Ethylidenic Chloride.—M. Simpson. The action of potassic hydrate upon ethylic cyanide resulting in the formation of succinic acid led the author to expect that an isomeric acid would be obtained if instead of ethylenic, ethylidenic cyanide were taken. No isomer, however, but ordinary succinic acid is formed, and this apparent anomaly is explained by the supposition that during the process of heating ethylidenic chloride with potassic cyanide (180° C. being the temperature required) the former is partially converted into ethylenic chloride by an exchange of places between hydrogen and chlorine :—

$$\left\{\begin{matrix}CH_2H\\CHCl_2\end{matrix}\right. = \left\{\begin{matrix}CH_2Cl\\CH_2Cl\end{matrix}\right.$$

—(*Comptes R.*, lxv., 351.)

Aldehyde and Cyanhydric Acid.—M. Simpson and A. Gautier. Equal mol. of acetic aldehyde and dry cyanhydric acid unite by direct addition, when exposed for ten to twelve days to a temperature of 20° to 30° C. The body thus formed has the composition CNH,C_2H_4O. It is a colourless, oily liquid, boiling at about 183°, but rapidly resolving itself into its constituents at that temperature. It is soluble in water and in alcohol, absorbs ammonia readily, and when heated with it to 100°, is converted into a syrupy mass of basic properties. The action of chlorhydric acid and water upon cyanhydric aldehyde gives rise to the formation of *lactic acid* according to the following equation :—

$$CNH,C_2H_4O + HCl + 2H_2O = NH_4Cl + C_3H_6O_3$$

(*Comptes R.*, lxv., 414.)

The Velocity of Light, according to a calculation recently published by Professor Chase, of Boston, is nearly the same as would be acquired in one year by a falling body under the influence of an accelerating force equivalent to the force of gravitation at the earth's surface, viz., $32\ 1{\cdot}6 \times 86.400 \times 365\frac{1}{4} \div 5{,}280 = 192{,}254$ miles per second.

CORRESPONDENCE.

CRYSTALLOGRAPHY AND THE BLOWPIPE.

To the Editor of the Chemical News.

SIR,—Below I have the pleasure to send you the translation of a letter I have just received from Professor Richter, head of the University of Freiberg, where he succeeded the late celebrated Plattner. It is indeed gratifying to me to think that my trifling endeavours should engage the attention of such a man.

His want of success in making the vesicles at first, may be explained by the fact of my not having mentioned (as I ought to have done) that, in blowing the vesicles, the bead should not be operated on until it has partially cooled down to a red heat, as at a high temperature the current of air is too strong for the small density of the fluid borax, which it soon bursts.

I take this opportunity of mentioning two facts in addition to those stated in my paper on this subject, published in the CHEMICAL NEWS of the 20th December. One, that the smallest imaginable particle of reduced metal, as for instance copper, may be clearly observed in one of these vesicles by a microscope, whereas in a bead it might be buried in the centre and escape observation. The other, that eight or ten vesicles kept by me for three weeks at Christmas, became first black and then clear after efflorescing, on being re-melted by a blowpipe flame projected from a spirit lamp,—showing the presence of free carbon, or organic matter, which could not have been there when the vesicles were formed. I will, with your permission, continue this subject shortly.—I am, &c.,

W. A. ROSS.

(Copy.)
Freiberg, 1st January, 1868.

DEAR SIR,—If I have not answered your letter of the 9th December before to-day, I trust you will kindly excuse the delay, which is owing to my having been so busy. The observation that various earths and metallic oxides may be dissolved in borax and phosphor salt, and preserved crystallised under certain circumstances, was made and described some years ago by George Emerson,[*] an American, and published in the *Proceedings* of the American Academy of Arts and Sciences, March, 1865, vol. vi., where drawings of the beads may be found. Also, G. Rose, of Berlin, has lately described the production of crystallised bodies by means of the blowpipe in borax and phosphor salt. The article is found in the monthly report of the *Proceedings* of the Royal Academy of Sciences in Berlin, for March and July, 1867, with drawings. I have verified by my experiments the statements of Messieurs Emerson and Rose, and suspect that the interesting discoveries made by you are intimately connected with those phenomena.[†]

I have also attempted to make borax vesicles from your description, but have not realised a satisfactory result, probably from unskilfulness in manipulation.

It would certainly prove a grateful task to study more closely this relation of bodies to each other, in order to be able to use it at the same time as a means of their recognition. I recommend to you the perusal of the abovementioned experiments of Messieurs Emerson and Rose, and I shall be glad if you will inform me of the result of your further labours,—With great esteem, I remain, yours, &c.

(Signed) THEODORE RICHTER.

To Captain W. A. Ross, R. A., Woolwich.

VOLUMETRIC DETERMINATION OF IRON.

To the Editor of the Chemical News.

SIR,—The method proposed in the last week's CHEMICAL NEWS, by Captain Ross, for the volumetric assay of iron by the decolorisation of the iron solution coloured red by sulphocyanide by means of a standard solution of lime water, appears to be inapplicable, inasmuch as the amount of lime requisite depends, not on the quantity of iron present, but on that of the acid in the solution to be tested. The bleaching effect of the lime is caused by the decomposition of the ferric sulphocyanide, whereby ferric hydrate is precipitated, and calcium sulphocyanides produced; but this effect does not take place until not only the whole of the free acid present is neutralised, but also almost the whole of the iron precipitated as hydrate. In practical analysis a solution of iron without free acid is never obtained; nor could the solution be neutralised by addition of alkali, because the point when the free acid is just saturated cannot be observed either by test-papers (as ferric salts have an acid reaction) or by the commencement of a precipitate, as ferric hydrate is soluble in solutions of ferric salts.

I have frequently had occasion to examine acid liquids containing metals in solution with a view to the determination, firstly, of the free acid, and secondly, of the total acid free and combined (as, for example, in the waste manganese chloride of the bleaching powder works). This second quantity is readily ascertainable by adding a standard alkaline solution to the acid liquid examined until an alkaline reaction is observed; but whenever ferric salts were present, the exact determination of the first quantity was found impossible from the solubility of the ferric hydrate; even Kiefer's very convenient process for estimating free acid in solutions containing heavy metals by means of an ammoniacal solution of a cupric salt always indicated a larger amount of free acid than was really present, from the circumstance that as soon as a turbidity was produced by the precipitation of cupric hydrate from the neutralisation of the ammonia (the terminal reaction), it disappeared on agitation, the cupric hydrate apparently decomposing the ferric salt, and thereby being dissolved, whilst the newly-precipitated ferric hydrate also dissolved in the remaining ferric salt.

The destruction of the red ferric sulphocyanide by alkalies might be used as a terminal reaction in acidimetry; but on trial the sulphocyanide appears to be inferior to the ferrocyanide (Prussian blue) as an indicator; and this latter is not so convenient as litmus or cochineal tincture as usually employed.—I am, &c.,

CHARLES R. A. WRIGHT, B.Sc.

Chemical Laboratory, St. Mary's Hospital, W., Jan. 13, 1868.

MISCELLANEOUS.

Nitroglycerine.—While the explosive nature of this compound is still exciting attention, it will be interesting to give the evidence with regard to the cause of an explosion in the United States, resulting in fatal consequences, deposed to by Professor Doremus, one of the most distinguished of American chemists. The circumstances under which the accident took place are briefly these. The Central Railroad Company are making a deep cutting near South Bergen, N. J., and in effecting this they use nitroglycerine. A can containing about sixty pounds of this oil, having partially solidified, was carried by a workman to the blacksmith's shed, where it was placed in water, red hot bars of iron being plunged into the latter. Suddenly an explosion occurred, killing nine men.

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[*] This, as stated by me in the CHEMICAL NEWS of Jan. 3, is a misapprehension, the crystals having been formerly pointed out by Berzelius and others.

[†] They appear to have the relation to each other that masses of ice bear to the delicate crystals of frost.

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At the inquest Professor Doremus said:—"On Dec. 2, I received from the coroner two bottles of nitroglycerine, with a request to report upon its properties; I have subjected it to ultimate chemical analysis, and find it is well-made nitroglycerine; the substance freezes at about 46°; it is made to decompose in a very peculiar way; on moistening paper with it, it burns with rapidity; it does not explode when red-hot copper is placed in it; we tried it with the most intense heat we can produce with a galvanic battery, with two hundred cells holding a gallon and a-half each; some nitroglycerine was placed in a cup and connected with one of the poles of the battery; through a pencil of gas-carbon the other poles of the battery were connected with the glycerine; no explosion ensued; but when the point touched the Britannia vessel the nitroglycerine took fire, a portion burning and the rest scattering about; this is as severe a test as we can submit it to in the way of heat under the pressure of the air; we, therefore, would conclude that nitroglycerine carried about exposed cannot explode, even if you drop a coal of fire into it; if the liquid is confined, or is under pressure, then an explosion will ensue; if paper be moistened with it and put on an anvil and a smart blow given with a hammer, a sharp detonation ensues; if gunpowder or the fulminates of mercury, silver, or gun-cotton be ignited in a vacuum by a galvanic battery, none of them will explode; if any gas be introduced so as to produce a gentle pressure during the decomposition, then a rapid evolution of gases will result; the results of decomposition in a vacuum differ from those under atmospheric pressure or when they are burnt in a pistol, musket, a cannon, or in a mine; where we have little or no pressure it is difficult to get these substances to burn rapidly; nitroglycerine is more difficult to explode than powder; in many respects it resembles gun-cotton, which is made in a similar way. If gun-cotton be immersed in protochloride of iron it turns into common cotton; the same experiment was tried with nitroglycerine by mixing it with proto-chloride of iron, and it reverted into common glycerine. There are four well-known varieties of gun-cotton made by employing acids of different strengths; they differ in chemical composition and properties, as well as in their explosive qualities; the late Minister of War in Austria, in 1862, stated to me that he had ordered 400 cannon for gun-cotton, and six months after he stated that he had ordered all the cannon to be changed and adapted to powder in consequence of spontaneous combustions; much less is known of nitroglycerine than of gun-cotton, and probably several varieties of this article may be formed, as of gun-cotton; this would explain cases of spontaneous explosion; if the nitroglycerine is not carefully washed to get rid of the acid, a gradual decomposition will ensue, producing gases which, if the vessel be closed, will explode. My opinion is that nitroglycerine should be used in the most careful hands; I do not think I would put it in the hands of a common labourer for blasting purposes; it is less dangerous in a frozen than a liquid state; I think concussion would explode frozen nitroglycerine. . . . . Since leaving I have learned that the can of nitroglycerine, the explosion of which proved so fatal, was full of frozen or solid nitroglycerine. Now, although the cork might have been removed, it is possible that the red-hot irons melted and decomposed the material at the bottom of the can, leaving a quantity of solid nitroglycerine above, which, by preventing the escape of the gases, produced the pressure required for an explosion. A red-hot iron, or the more intense heat of a powerful galvanic battery, will not explode the nitroglycerine unless it is under pressure. This stopper of frozen nitroglycerine might have closed the orifice of the can sufficiently to produce the required pressure." Amongst other evidence was the following:—Otto Bürstenbinden said: I am now in the blasting business, and reside in the City of New York; nitroglycerine is composed of nitric acid, sulphuric acid, and glycerine oil; it is a liquid of light yellow colour, and about six-tenths heavier than water; in exploding it expands 10,400 times, and powder expands about 800 times; this compound called nitroglycerine will not explode by simple contact with fire; it requires about 360 degrees of heat to make it explode; it will not easily explode by concussion or friction when fluid, but it changes its qualities entirely when frozen; if frozen it will explode very easily by a stroke or slight concussion.—Wm. H. White said: I reside in Syracuse, and for the past two years have turned my attention to the use of nitroglycerine; I know that it is no more explosive when frozen than when in a liquid state; frozen, it is less liable to explode; it is very hard to explode a cartridge when frozen; a very heavy weight coming on nitroglycerine either in a frozen or liquid state would explode; I have seen a man let a can of frozen nitroglycerine fall from his shoulder on a rock without exploding it; I consider nitroglycerine twenty-five times safer than powder for blasting purposes; I have seen a chunk of nitroglycerine as big as my hat cut open with an axe.—The jury brought in the following verdict:—"We find that the deceased came to their deaths on the 25th day of November last by the explosion of a can of nitroglycerine, consequent upon the careless handling of the same by Thomas Burns, one of the deceased, and we censure the contractor, Colonel Schafner, for not being more careful in the selection of a man to use the article of nitroglycerine, and recommend that in future men should be employed in its use who understand its explosive qualities, and we request the Council of the town of Bergen to order that there shall not be any more than 100 pounds of nitroglycerine stored up or kept in the town of Bergen, the same to be stored in a fire-proof vault when not required for use."

Dietetic Salt.—One of the great evils that owes its origin to the scientific enterprise of the present age is that any promising scientific scheme, after being brought into prominent notice, becomes for the time being quite the fashion, and is then entirely forgotten, often, too, from mere caprice. We hope that this fate may still be averted from Dr. Lankester's ingenious scheme of supplying necessary but frequently overlooked articles of diet, by means of his dietetic salt. This compound is a proposed substitute for ordinary table salt, chloride of sodium being a notable constituent; but, in addition to this, which is far from being the sole or even most important inorganic constituent of our food, we have phosphate of lime, chloride of potassium, sulphates of potash and soda, with smaller quantities of magnesian and iron salts. The argument for their use is very strong. Leaving out the large proportion of epidemics, almost all the common diseases are directly traceable by modern physicians to dietetic errors; and those that certainly are due in part to deficiency of inorganic food form by no means a contemptible list. Scurvy is known to arise from a deficiency of the salts of potash. Scrofula and consumption, rickets, and softening of the bones, occur when the phosphates of lime and other bases are deficient. Anæmia, chlorosis, and a variety of nervous disorders, are the result of an absence of iron, and are at once cured by the use of this agent as a remedy. In such cases, the medical man is in the habit of prescribing medicines containing these agents; and there can, therefore, be no doubt that the habitual use of these substances in the food, in the same way as common salt is employed, would be a means of preventing the occurrence of a large number of diseases. The quantities of the saline ingredients employed, in addition to common salt, are so calculated that they shall be supplied in the same proportion by its use, as they exist in the human blood, and are got rid of in the body. Dietetic salt is one of those simple but useful applications of science of which the value is at once perceived; it deserves to hold a prominent place in the rank of articles of food, and it is to be hoped that it will not be lost in the crowd of similar inventions.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Comptes Rendus.
October 14, 1867.

Chasles, "Answer to Faugère's Letter, on the Authenticity of the Newton and Pascal Correspondence." Morin, "Observations on some Correspondence between James II. and Louis XIV., recently brought under the notice of the Academy, *àpropos* of the Newton and Pascal Controversy." Le Verrier, "On the Authenticity of the Newton and Pascal Correspondence." Sir D. Brewster, "On the Question of the Application of Dioptric Lenses to Lighthouses." J. Fournet, "On the Path of Thunder Storms over various Parts of Switzerland." J. Lemaire, "On the Presence of Bacteriums and other Organisms in Emanations from the Human Body." Faugere, "Letter on the Authenticity of the Newton and Pascal Correspondence." G. Kirchhoff, "On the Theory of Sun Spots." Fordos and Gelis, "Remarks on Riche's and Kolb's Memoirs on the Nature of the Chlorides used for Bleaching."

October 21.

Sir D. Brewster, "Additional Letter to Chevreul on the Nature of the Relations which existed between Newton and Pascal." Chasles, "Reply to Le Verrier's Note respecting the Authenticity of the Pascal and Newton Correspondence. "Observations on Faugere's last Letter." "Reply to Sir David Brewster's Letter to Chevreul." Babinet, "Note on the Precise Date of the Establishment by Sir Isaac Newton of the Laws of Attraction." Faye, "Remarks on Kirchhoff's Letter, published in the *Comptes Rendus* for October 14, on the Theory of Sun Spots." C. Deville and Janssen, "On the Submarine Eruption which took place between the Islands of Terceira and Graciosa, Azores, on the 1st of June, 1867." Chevreul, "On the same Subject." Fouqué, "On the Gases disengaged during the Submarine Eruption at the Azores on the 1st of June, 1867." A. Dronke, "Note on the Formation of Crystals of Gypsum." D'Archiac, "Remarks on the Foregoing Paper."

Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften zu Wien. (Mathematisch-naturwissen-schaftliche Classe.)
April—May, 1867.

E. Schwartz, "On the Use of Picric Acid and other Substances for preparing Microscopic Objects in Two or more Colours." "Report on the Prize of 1000 Florins for an Essay on the Progress of Mineralogy during the Years 1862-65."

Poggendorff's *Annalen der Physik.*
August 7, 1867.

E. Edlund, "On the Property possessed by a Voltaic Current of causing Solids to expand independently of the Heat produced by the Passage of such Current." C. Rammelsberg, "On the Phosphites." E. Schone, "On the Compounds of Sulphur with the Metals of the Alkalies." H. W. Schroder van der Kolk, "On the Mechanical Energy of Chemical Combination: Combustion." "Reply to H. Deville's Remarks on the Author's Paper on the Theory of Dissociation." F. Melde, "On a peculiar Mode of Formation of Sound Pulses and on a Method of Counting the same." R. Weber, "On some Compounds of Chloride of Platinum and of Chloride of Gold." F. Goppelsroeder, "On a Fluorescent Substance obtained from Fustic." K. L. Bauer, "On the Refraction of Light and on the Angle of Minimum Deviation in Prisms." H. Gerlach, "Contributions to the Mechanical Theory of the Voltaic Current." Hoh, "On some Remarkable Effects of Lightning." J. C. Poggendorff, "On the Mutual Reaction of Two Induction Machines.

NOTES AND QUERIES.

Aniline Dyes.—Could you kindly inform me as to the best method of stripping off the aniline dyes of goods, and if any book is published on the manufacture and method of dyeing these colours?—W. P. B.

Mordant for Green on Cotton.—If W. T. C. will send his address, T. Charlesworth, jun., Leicester, will send him the required mordant.

Mordant for Green on Cotton.—Je viens de lire dans votre dernier numero, qu'un de vos correspondants cherche à avoir le procedé d'application du nouveau vert sur coton. Comme je suis aussi bien teinturier que fabricant de produits chimiques, veuillez dire à votre client de m'envoyer quelques livres de coton, que je teindrai par mon procédé en nouveau vert. Ci-inclus un échantillon de coton teint par mon procédé. Dans l'attente de vos nouvelles; veuillez recevoir, Monsieur le Directeur, &c.—Pierre Clavel. Bale, le 13 Janv., 1868. [The specimen of dyed cotton mentioned by M. Clavel, can be seen at our office.]

Diphenylamine.—Could you inform me how I might make diphenylamine? There is a process mentioned in "Watt's Chem. Dict."; but so expensive, that it is impossible to use it. There must be another plan of making it, I believe, for I find a process which speaks of commercial diphenylamine.—Ignoramus.

Extraction of Oil.—Dyeing Turkey Red.—Will you kindly inform your correspondent "E.," of Notes and Queries of 20th of December last, that if he will correspond with me on the subject on which he inquires, I shall be happy to give him all information necessary.—Rudolph Schomburg, Uccle, Belgium, 2 Jan. 1868.

Constant Galvanic Current.—The following observations may have occurred to others, but not having met with them published, they may be of value as tending to the perfection of our scientific instruments, by providing the source of a constant galvanic current, of large quantity and very great intensity. The bichromate of potash battery furnishes a current of great force, and its simplicity, economy, and convenience of management would make it preferable to the double fluid batteries, but for its want of constancy when a current of large quantity is required. Experimenting with it lately, I became satisfied of the cause of this defect. Although there may be a large reservoir of liquid, only the stratum between the plates is active, and as no gas being given off there is no circulation; this soon becomes exhausted, and as it is renewed merely by diffusion, can only maintain a current equivalent to the fresh supply of liquid thus obtained. I therefore used a thin beaker as the containing vessel and placed it over a Bunsen's burner capable of maintaining a moderate circulation of the liquid, and as I expected, the battery now gave its fullest force with absolute constancy until the complete exhaustion of the exciting fluid. Mechanical stirring of the liquid or motion of the plates will produce a similar result; and thus by any of the various modes which may be employed, this battery can be made to yield a current more powerful than any other known form, without giving off any noxious gases, and as absolutely constant as can be desired.—John T. Sprague.

MEETINGS FOR THE WEEK.

Monday.—Medical, 8 p.m.
—— Society of Arts, 8 p.m. Cantor Lectures, "On Food," by Dr. Letheby. Lecture 1. Varieties of Food; their Chemical Composition, and their Nutritive Value.
Wednesday.—Society of Arts, 8 p.m. "On the Reports of the Artisans selected to visit the Paris Universal Exhibition of 1867," by W. Hawes, Esq.
—— Geological, 8 p.m. "On the Specton Clay," by John W. Judd, Esq. F.G.S. 2. "Notice of the Hessle Drift as it appeared in Sections above forty years since," by Professor John Phillips, F.R.S., F.G.S., &c.
Thursday.—Royal, 8½ p.m.
—— Zoological 8½ p.m.
—— Royal Society Club, 6 p.m.
Friday.—Royal Institution, 8 p.m. "On Faraday as a Discoverer," by Dr. Tyndall, F.R.S.
Saturday.—Royal Institution, 3. "On the Non-metallic Elements,' by Professor Roscoe, F.R.S.

TO CORRESPONDENTS.

W. Bird Herapath.—Received with thanks. A proof shall be forwarded shortly.

Moonstone.—Amongst mineralogists the name moonstone is applied to one of the varieties of felspar. Fine specimens possess a certain value, but they cannot legitimately be called gems. Adularia is another name for the same stone.

Physic.—Test the deposits for urate of soda. They are probably "chalk stones."

O. Reiman.—There are no less than 52 separate products of the destructive distillation of coal. It would occupy nearly the whole of this column to give the list. Dr. Frankland's Lectures on Coal Gas (reported in this journal in the spring of last year) will give you full information on this point.

H. D. S.—There are many reasons against the supposition that the chemistry of silicium and of boron would be as extensive as that of carbon if fully investigated. The gaseous character of the oxides of carbon, as contrasted with the fixed nature of the silicium and boron oxides, and the difference between the hydrogen compounds of one and the others, are much against the view which some chemists have adopted. At the same time it must not be forgotten that the number of organic compounds containing silicium is increasing daily.

Surprise.—We have the best reason to believe that the rumour of the "distinction," which it is said is about to be conferred, is unfounded. It would in fact be almost an insult to offer it to such a man.

W. Gellett.—Dr. Odling will deliver Four Lectures on Chemical Combination, after Easter, at the Royal Institution.

Student.—Apply to Ernest Hart, Esq., Dean of the School, St. Mary's Hospital Medical School.

Haffa.—The existence of native zinc in nature is considered somewhat problematical.

H. Hordliczka.—Your communication has been forwarded to the required address. You will most likely hear direct by post. If any difficulty occurs about sending letters we will communicate through this column.

N., Hoxton.—Write to the Secretary, Burlington House, W.

Communications have been received from Dr. Muspratt; J. C. Lee; H. R. Marsden; D. Dawson; Dr. Quesneville; S. Rowland; L. Wundt; Rev. J. T. Burt; J. L. Tgelström; Runcorn Soap and Alkali Company; F. C. Clayton; T. Charlesworth, jun.; Captain W. A. Ross; J. F. Sprague; J. How; J. Walker (with enclosure); Dr. Andrews (with enclosure); V. Cruse; Dr. Herapath, F.R.S.; Dr. W. Kellner; J. Butterfield; R. Nicholson; F. C. Calvert and Co.; Rev. A. Rigg; Dr. Letheby (with enclosure); W. H. Exall (with enclosure); M. Murphy (with enclosure); L. Benzon; J. C. Bell; J. Sprague (with enclosure); E. M. Delf; J. Spiller; W. J. Day; Professor Heaton; C. R. C. Tichborne (with enclosure).

Books Received.—"Street Tramways for London," by Charles Mackay, LL.D. London: P. S. King; "First Step in Chemistry," by R. Galloway, F.C.S., fourth edition. London: Churchill & Sons.

Scholl's Patent Platinum Gas Light Perfecter. —Extract from Report by Dr. Letheby:—

" The results have been very remarkable, for they show an average increase of 63 per cent on the illuminating power of the gas. I am of opinion, therefore, that the invention is of great practical value.' Price One Shilling each for Fish-tail Burners. To be had retail of Gas-fitters and Ironmongers, and (wholesale only) of JOHN SCHOLL, 41 and 42, Berwick Street, Oxford Street, London, W. Terms on application. N.B.—A specimen sent free on receipt of 12 stamps.

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LECTURES.—On Chemistry and Pharmacy, by Professor Redwood. On Botany and Materia Medica, by Professor Bentley.

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Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c.

TO PHARMACEUTICAL AND OTHER STUDENTS.

Mr. J. C. BRAITHWAITE, for thirteen years Principal Instructor in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c., wishes to inform his old Pupils and others that he continues to devote his whole attention to Education. The Session 1867—1868 will commence on the 1st of October, when

Mr. BRAITHWAITE'S Laboratory, which has been enlarged during the recess, will be re-opened at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS meets as usual every Monday and Thursday Evening, at 8 p.m., commencing October 3rd.

The LATIN CLASS for the reading of the Pharmacopœia, Physicians' Prescriptions, &c., every Tuesday and Friday Evening, at 8 p.m., commencing October 1st.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday Evening, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will commence at 10 a.m., October 2nd.

Fee to either of the above Classes Half-a-Guinea per Month; to the Botanical Excursions only. Half-a-Guinea per Eight Lessons, payable in advance. Pupils can enter at any period.

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Mr. J. Tennant, Geologist, 149, Strand, London, W.C., can supply Elementary Collections of Minerals, Rocks, and Fossils, to illustrate the Works of Ansted, Lyell, Jukes, and others, on the following terms:—

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CANDLES, GLYCERINE AND SOAP. A Gold Medal was awarded at the Paris Exhibition to Price's Patent Candle Company, Limited, for "Candles, Glycerine, and Soap"—the only one to any British Exhibitor for these three things combined. The chief Candles of the Company are their "BELMONTINE" and "PRICE'S PARAFFINE" for those who must have the extreme transparency of pure Paraffine; their GOLD MEDAL PALMITINE" and "SHERWOOD PALMITINE" for those who, while desiring candles of great beauty, require also steady brilliancy of light and freedom from smoke and smell; their good old-fashioned "BELMONT SPERM AND WAX," and "BEST," "No. 2," "No. 3," and "BATTERSEA" COMPOSITES for those who require only perfect burning without caring for transparency; and their "CHAMBER" Candles, hard, and of small diameter to avoid the dropping of grease when carried. Their new toilet soap, "PRICE'S SOLIDIFIED GLYCERINE" contains half its weight of their distilled Glycerine, and should be the one toilet soap in use, especially in winter, because of its admirable effects in preventing chapping of the hands and face. There ought also to be in every house one of the sealed bottles of their patent distilled Glycerine, known everywhere as "PRICE'S GLYCERINE," two or three drops of which, mixed with three or four times as much water, will in a day or two remove chapping and roughness of skin, whether of adults or children; and when this is effected, a single drop of the undiluted Glycerine applied once a day will prevent the recurrence of the chapping and roughness. Insist on having "Price's Glycerine" in the Company's own sealed bottles, quantities of cheap impure Glycerine being now sold in the shops because of the low rate at which the dealers can buy it in comparison with Price's. All the good medical authorities abroad as well as at home order "PRICE'S" as the one only Glycerine to be used.

"PRICE'S NEW PATENT NIGHT LIGHTS" for burning in the wide glasses, are believed to be the very best Night Lights made. "PRICE'S CHILD'S NIGHT LIGHTS" are known everywhere and are excellent for burning without a glass.

THE CHEMICAL NEWS.

Vol. XVII. No. 425.

ON SOME POINTS IN CHEMICAL GEOLOGY.

By DAVID FORBES, F.R.S., &c.

No. II.—Dr. Sterry Hunt's Geological Chemistry.

In the Chemical News of October 4, 1867, I commenced some remarks under this title, for the express purpose of exciting more interest in the application of chemistry to geology, and with the hope of starting a discussion, which might at the same time enliven as well as elucidate the subject. Accepting Dr. Hunt's invitation, his views, being the most recent, were first selected for consideration; and, although that gentleman now appears greatly astounded at my presuming to differ from his opinions, it is still highly gratifying to find that he has at last condescended to reply.

As this reply, however, contains absolutely nothing which can in any way affect or modify the opinions which I have already expressed on the views of Dr. Hunt, or even require a reconsideration of the arguments upon which those opinions were based, I am enabled to reply *tout de suite*.

Dr. Hunt adopts a line of argument which is an elaborate attempt to convince his readers of the utter incompetency and ignorance of his reviewer; yet at the same time, it is amusing to observe that the character and tone of his remarks, in conjunction with his studious avoidance of some of the knotty points, and more important arguments brought forward in opposition to his views, are strikingly suggestive of his being in reality ill at ease, and possibly afflicted with a presentiment that there may, after all, be some rickety points in his theoretical views.

Men who live in glass houses should not throw stones; Dr. Hunt's accusations of ignorance will appear strange to those who have paid attention to some of his sweeping assertions: amongst others, for example, when he emphatically declares that quartz "can only be generated by aqueous agencies," geologists will infer that Dr. Hunt must be ignorant of the most important fact that quartz is found in abundance in volcanic lavas in many parts of the world, although not in Canada.

Had Dr. Hunt remained content with his Canadian laurels, he would probably have enjoyed them in peace without having his opinions disputed, but when he now aspires to be recognised in Europe, he cannot complain if his views be criticised by any, or all, of those interested in the subject; an ordeal which must be undergone before he can expect them to receive general acceptance, for surely he does not issue them as axioms or oracles.

Europe differs greatly from Canada, and, amongst other things, in close competition being the order of the day. No man in Europe can expect to retain any portion of the field of science exclusively for himself, or to travel alone on any of the many different roads, which lead to one and the same scientific truth.

If real progress is to be made in science, the student must reason for himself and not be content with accepting, merely on authority, opinions which are inconsistent with his own deductions or experiments; nor should he be deterred by the opposition to be exexpected from those already in office or authority, who are sure to be jealous of intruders on what they imagine to be their own domain, and, doubtless, also dislike having their peace of mind disturbed by innovations.

A discussion of this nature may be carried on in two ways; either by considering the main points of the argument first, before engaging the minor details, or the reverse. Dr. Hunt prefers the latter course, which no doubt is best suited to the defence of a weak cause, but which, as his rather rambling remarks in last week's Chemical News[*] will show, is not calculated to convey to his readers any very clear idea of the exact points at issue, and likely to confuse by the number of minor details having little or no bearing on the main questions.

It is therefore most important to me that no misunderstanding should arise as to the exact points on which I have presumed to differ from the principles of chemical geology which Dr. Hunt has recently brought before the scientific public in Europe.

Expressed in as few words as possible, I object to the following of Dr. Hunt's assumptions or assertions:

1. That the earth is solid to the core.
2. That the surface of the earth immediately previous to its entire solidification was "a liquid bath of no great depth surrounding the solid nucleus."
3. That the original atmosphere contained "the whole of the chlorine in the form of hydrochloric acid—the sulphur as sulphurous acid."
4. That the saltness of the sea is due to a rain of hydrochloric acid "flooding the half cooled-crust" with a highly-heated acid deluge.
5. That the whole of "the calcareous strata—the marbles and various limestones which we find on the earth's surface"—have been precipitated from the sea by carbonate of soda.
6. That all the magnesian limestones and gypseous beds were formed in a dense atmosphere of carbonic acid.
7. That quartz "can only be generated by aqueous agencies."
8. "That granite is in every case a rock of sedimentary origin."
9. That volcanic rocks are merely ordinary sedimentary beds melted by being "depressed so that they come within the action of the earth's central heat."

Any minor differences fall naturally under these heads, and I may add that the perusal of Dr. Hunt's defence has confirmed me more than ever in the belief that the above premises are unsound; and I shall now endeavour as concisely as possible to examine the arguments *pro et contra*.

1. That the earth is solid to the core.

Dr. Hunt seems to imagine that if the earth is not solid to the core, it can only consist of an immense central sphere of molten matter covered by a thin external crust or shell: for he wastes all his arguments in attempting to upset this theory, to which I had never given my adhesion. I have preferred adopting in the main the hypothesis of Bunsen, no mean authority, and when opposing Dr. Hunt's view, simply asserted my opinion, that the earth still encloses "a vast reservoir or reservoirs of still fluid igneous matter in its interior," and the main argument with which I support this opinion is, that I consider that the molten lava ejected from volcanoes must be derived from some such source. This is a very simple but common sense view of the case, which I imagine Dr. Hunt will find some difficulty in refuting.

2. That the earth's surface immediately previous to its entire solidification was "a liquid bath of no great depth surrounding the solid nucleus."

Hopkins has taken into favourable consideration, the supposition that the earth actually was solid both in its centre and crust, and yet might retain fluid igneous matter in the intermediate space, and taking a somewhat similar view of the case, I believe that, even allowing that the solidification actually did commence at the centre, that it still could not have reached the exterior before, on the other hand, the surface itself had also solidified and formed a crust commencing from the exterior, due to the external cooling action. In opposition to this, Dr. Hunt states that silicates when cold are from one-seventh to one-sixteenth part more dense than when molten, and would at once sink down into the fluid mass below, and further adds that no crust could be formed unless the laws of gravity were suspended. I do not know what Dr. Hunt's ideas of the laws of gravity may be; but would again ask how far he imagines a crust of sp. gr. 2·6 could sink down into a molten sphere of a mean sp. gr. 5·3 ?.

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[*] It is necessary to explain here that many of Dr. Hunt's observations refer to a previous communication in the October number of the *Geological Magazine*, and not to the subsequent one in the Chemical News of October 4th, which, as is distinctly stated therein, is only supplementary to the former, and to be read in conjunction with the same. Yet Dr. Hunt indulges in the absurd accusation that the contents of that communication "have for some unknown reason been withheld from the readers of the Chemical News."

I will not, however, repeat the other arguments which I have used in the *Geological Magazine*, but content myself by bringing forward one not before employed by me in support of my opinion.

Some experiments which I am now engaged in, on the effect of heat upon bodies which contract in cooling, *i.e.*, which are more dense when cold than when molten, show in the cases tried, that a body upon the first application of heat expands and continues to do so up to near its melting point, when it contracts at the instant of fusion; in other words, although the substance when cold was heavier than when molten, yet the same substance expanded by heat was lighter than when molten. Thus some metals were found to float about (like ice upon water) upon the surface of a molten bath of the same metal, into which they were placed in a heated condition[*]. It appears probable that the same phenomena would account for such a crust as Dr. Hunt disputes, not sinking, but floating on the molten bath below.

That the earth may possibly have solidified at the centre first, is not disputed by me, nor does its so doing in any way affect my theoretical views. The object of my observations on this head were to show that we are altogether too ignorant of the character of the central mass of the earth, and of the effect likely to be produced by such enormous pressures, to be enabled to reason on such insufficient data with any confidence in the result.

3. That the original atmosphere contained "the whole of the chlorine in the form of hydrochloric acid—the sulphur as sulphuric acid.

The perusal of Dr. Hunt's remarks does not in any way tend to modify the conclusions I had previously arrived at on this head; I still believe that chemists will not be disposed to regard an atmosphere containing enormous volumes of sulphurous acid, steam, and oxygen in excess, or in other words, which resembles a great sulphuric acid chamber, as *probable*, and as Dr. Hunt does admit that they would slowly unite to form sulphuric acid, it merely becomes a question of time as to whether they united slowly or quickly.

The arguments I advance against supposing that such an atmosphere ever did exist, are that I consider that the sulphur would unite mainly with the heavier metals, and the chlorine mainly with the alkaline metals, and I consequently infer, that these elements never went into the atmosphere in any such quantity as Dr. Hunt imagines.

Dr. Hunt in opposition states that sulphides could not be formed, since oxygen was in excess. Metallurgists know that sulphides are far less easily oxidisable than are generally imagined, and that they are produced in both blast and air furnaces, where the waste gases still contain unconsumed oxygen; and that time is an important element in this consideration.

But we have no proof whatever of any great excess of oxygen in the primeval atmosphere; on the contrary, we know that a vast amount of the oxygen now present in the air, must have been derived from the decomposition of the carbonic acid, when the immense supplies of carbon, afterwards buried in the various sedimentary formations were extracted from the atmosphere by the action of vegetable life. The slight excess of oxygen which no doubt was present would further be so diffused through the enormous volume of carbonic acid, nitrogen, and aqueous vapour, that it cannot be imagined to have exercised other than a most feeble oxidising action.

The carbonic acid, also, being so infinitely more dense, and present in so overwhelming quantity, would further act as a powerful shield against the very oxidising action which Dr. Hunt lays so much stress upon.

That the chlorine, also, did not go into the atmosphere as Dr. Hunt imagines (combined with hydrogen as hydrochloric acid), I infer, from the well known greater affinity which it has for sodium than for hydrogen, and the volatility of sodium would be far more likely to bring it in contact with the chlorine than with the silica.

The idea that the action of the feeble excess of oxygen above alluded to, in connection with silica and steam, would prevent the formation of chloride of sodium, is not of much weight; since the chloride of sodium would be formed as a vapour in the atmosphere, whilst the silica remained below in the earth's mass, in the solid form.

But Dr. Hunt next writes, "Even, if as Mr. Forbes supposes, the chloride of sodium were to be formed in the heated atmosphere, it would be precipitated into the intensely heated bath," &c.; *precipitated!* when it would be in the state of vapour at this temperature.

Metallurgists know how indifferent chloride of sodium is when fused with silicates, and to this property is due the employment of what is termed a salt cover in assays; however well the salt may be intermixed, once the mass is fused, it rises and swims on the top, and (if the heat be not too elevated, or protracted, as to volatilize it entirely) presents, upon cooling, a well defined crystalline crust of salt, below which is found the unaltered silicate slag, and below this again the button of metal, pure, or more or less in combination with sulphur, arsenic, antimony, &c., as the case may be; thus presenting, on the small scale, an illustration of what I have supposed may have occurred in nature, in which case, also, the cover, or crust of salt, would act as a shield against oxidation.

In a potter's kiln, the vapour of salt under confinement, merely glazes the surface of the ware to a minute depth, and this very glaze protects the silicates from further action: but both the potter's kiln and Gossage's soda process are worked under forced circumstances, not applicable in this argument; and when Dr. Hunt explains that in his illustration of this subject, he merely used the words "*if the elements were made to react upon one another*," is it not rather he who is trifling with the subject when he supposes conditions which never could occur in nature in the case referred to.

4. That the saltness of the sea is due to a rain of hydrochloric acid, "flooding the half cooled crust" with a highly heated acid deluge.

This assumption requires no further comments than those included under the preceding head, where I have endeavoured to show that the whole of the chlorine did not ascend into the atmosphere as hydrochloric acid, and, consequently, could not flood the earth with the hot acid deluge insisted on by Dr. Hunt.

5. That the whole of "the calcareous strata, the marbles, and various limestones which we find on the earth's surface" have been precipitated from the sea by carbonate of soda.

Geologists have long agreed that sedimentary limestones are the products of the action of organic life, and microscopists, in confirming this, have further proved that they do not possess the character of precipitates. Dr. Hunt evades any reply to these objections, but asks a question in return; requesting to know what becomes of the acid in case, as I contend, animals can utilise the salts of lime contained in the sea. As is well known, sulphur plays a very important part in vital economy, entering both into the composition of organism, and being also given off as sulphuretted hydrogen in the gaseous form. I see, therefore, many reasons for believing that animals do assimilate the sulphate of lime, which we know is contained in such an enormous quantity in the ocean.

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[*] As a metallurgist I have frequently observed such cases, but for a long time did not understand the explanation; I have to thank my friend Mr. Hackney for directing my attention to the behaviour of Bessemer steel under these circumstances, as it gives much trouble to the workmen by persistently floating high on the surface of the melted steel (even when in pieces of 40 lbs. and more) as long as its temperature is below its fusing point.

6. That all the magnesian limestone and gypseous strata were formed in a dense atmosphere of carbonic acid.

In 1846, when in Birmingham, I was informed that for some years the manufacture of magnesian preparations was based upon the reactions of the compounds of magnesia with carbonic acid in a compressed atmosphere of carbonic acid. In 1849, Mr. Osborne, a gentleman connected with a similar manufactory in Ireland, fully confirmed these statements, and shortly after the publication of Dr. Hunt's paper in the *Comptes Rendus*, Dr. Lawson, in the course of conversation, expressed his surprise at Dr. Hunt being unaware of this, since he knew that the principle had long been use in a manufactory at Cork.

Dr. Hunt has further applied this principle,[*] and obtained very interesting results, which he considered to be the counterparts of nature's operations; and remembering that there are dolomite beds in the lower silurian strata of Canada, at once asks geologists to believe the rather hasty generalisation that all the magnesian limestones and gypseous beds were formed in a dense atmosphere of carbonic acid.

Geologists, however, well knowing that the grand development of magnesian limestones and gypseous strata occurred in periods when air-breathing animals existed on the surface of the globe, could not believe that these animals actually lived in a dense atmosphere of carbonic acid; and had some of the more modern great gypseous formations occurred in Canada, Dr. Hunt would probably not have brought forward this theory.

7. That quartz "can only be generated by aqueous agencies."

Dr. Hunt, wisely, no doubt, does not take any notice of my arguments against this assertion, since they are facts, not opinions; and consist merely in pointing out that the volcanic lavas of Italy, Hungary, Peru, Bolivia, Chili, &c., contain abundance of quartz, often in well-defined crystals. In connection with this, I may here extract a passage from a letter received from Mr. Sorby, who writes: "I have splendid cases of recent lavas with quartz, both in the shape of small crystals and as rounded masses, like those seen in some older rocks, and this quartz, in both cases (crystals and rounded masses), contains splendid glass cavities just like those in the felspars, the Arran pitchstone, and the various lavas; thus we have complete proof, according to my views, that quartz both can and has crystallised out from a melted mass of rock."

Now, in face of such facts, what importance, may I ask, can be attached to such of Dr. Hunt's dogmatic assertions as "that the composition of the primitive crust would have excluded free silica;" that quartz "is only the result of a secondary process," &c.?

8. "That granite is in every case a rock of sedimentary origin."

Dr. Hunt makes this assertion in opposition to the opinion of many able men who have well studied the subject. If he, however, only founds this opinion on the presence of quartz in granite, the value to be attached to it may be inferred from the remarks contained in the preceding paragraph.

If he speaks as a geologist, it may fairly be inquired whether he considers his Canadian experience sufficient to enable him to arrive at such sweeping generalisations.

Sir Charles Lyell has stated that three things were essential to a geologist, namely, "to travel, to travel, and to travel;" and such advice may be recommended to Dr. Sterry Hunt before he ventures again to generalise for the world on the strength of a local knowledge of a very minute part of the same.

9. That volcanic rocks are ordinary sedimentary beds melted by being "depressed so that they come within the action of the earth's central heat."

In the *Geological Magazine* I ventured to inquire of "the author of this ingenious theory, by what mechanical arrangement he supposes strata on the surface of the earth to be lowered down into a globe solid to the core;" and again, "How are we, according to this theory, to account for the fact, that volcanic rocks, taken from any quarter of the world, no matter how far distant from one another—from Iceland or Terra del Fuego, from the islands of the West Indies, or from those of Polynesia,—that in all cases such rocks possess an absolute identity in chemical and mineralogical composition, in physical and optical properties. Can any geologist be expected to believe that such rocks have been formed by the melting up of a mere mechanical aggregate of rock débris, possessing no analogy whatsoever, and whose chemical composition, &c., is known to vary to the widest imaginable extremes?" Questions as yet unanswered.

Before concluding these remarks, I would here acknow- that Dr. Hunt has discovered an inaccuracy which occurs in my communication to the *Geological Magazine*, where the position of steam in the imaginary original atmosphere is by accident placed below that of air, although steam is in reality lighter, as a moment's reflection would have shown. This error has not the most minute influence on any of my generalisations, as it is perfectly immaterial whether this stratum be above or below that of air.

I shall always be ready to admit at once any error which may be found in my communications; still Dr. Hunt is quite entitled to make the most of such a blunder if he thinks it will support his views; at the same time I trust that he will also be equally candid in cases where he may be found tripping.

Dr. Hunt alludes to a rough sketch of some of my views contained in the *Geological Magazine*; but, as I have already accepted the invitation of the Council of the Chemical Society to give a lecture on chemical geology (20th February next), Dr. Hunt will thus be enabled to take my views into full consideration, and after comparing them with his own, I trust will give us the benefit of his scrutiny; for, as I regard the ultimate object of all my labours as being the attainment of scientific truth, I am as fully prepared to be corrected in points where I may be proved to be wrong, as to defend those which I hold to be right.

London, January 20th, 1868.

Simple Method for the Extraction of Phosphoric Acid from Glass.—From a consideration of the nature of either the basic or acid[*] materials used in the manufacture of glass, the presence of phosphoric acid in this substance would naturally be suspected, but as far as I know, this acid does not enter for certainty into any of the analyses of glass hitherto published; I am therefore induced to describe the following simple process for its extraction. Pound the glass to be examined extremely fine, and shake it up with twice its volume of weak ammonia, and allow it to rest until the supernatant liquid is clear, which will be in about 24 hours afterwards; the clear liquid is then ready for the molybdenum test. By this process I have already detected phosphoric acid in German glass test tubes, in Bohemian combustion tubes, and in several other glasses, into the manufacture of which lead does not enter.—*William Skey, New Zealand.*

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[*] *Vide* CHEMICAL NEWS, Sept. 13, 1867, p. 148.

[*] See in a former paper entitled, "On the property of silicic and Tungstic Acids to retain Phosphoric Acid, &c., CHEM. NEWS, Vol. xvi. p. 187.

ON

HEAT AND COLD;

A COURSE OF

SIX LECTURES[*]

(*Adapted to a Juvenile auditory*),

DELIVERED AT

THE ROYAL INSTITUTION OF GREAT BRITAIN,

(*CHRISTMAS*, 1867–8),

BY

JOHN TYNDALL, Esq., LL.D., F.R.S.

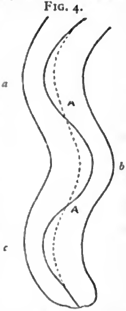
Lecture III.

(Continued from page 32.)

The Geysers of Iceland.

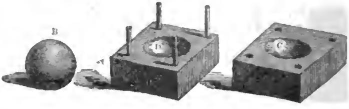
I want to show you now how it is that ice can behave like treacle, or honey, or tar—how it is that it behaves like lava, or paste, or a viscous body. In order to make this plain I have asked Mr. Cottrell to bring me in a mass of ice; and I hope to be able to show you by experiments in this room that we can make ice behave almost like a piece of paste—that we can mould it into any form we please. Here is our ice, and we will place it on the table in this blanket. It is clinging to the blanket, being, in fact, frozen to it. I will show you how, from an apparently little thing, we can get an explanation of a fact observed in the glaciers. This explanation is due to a little fact first observed by the greatest experimental philosopher that this world ever produced—a man who is to my feeling almost living here amongst us at the present moment—a man who lectured to the boys here, and who himself had all the tenderness, and all the brightness, and all the joyousness of a boy. I say it is by a little observation of this great man that we are able to explain those facts observed in connection with the glaciers, and to show how it is that a body so brittle as ice can behave almost like lava. I will show you the brittleness of ice. I have here a pointed instrument, a small awl, and if I prick this into the ice you see that it chips off little pieces, and that the ice breaks as clearly as any crystal would break. Now just observe what occurs among these glaciers. If we make accurate measurements upon this *mer de glace* we ascertain a very striking fact. You see in the diagram a great white glacier. Here you see another, and you see another there. I measured the width of the first glacier, and it was 1,134 yards. The second glacier is 825 yards; and the third 638 yards. If you add these together, the sum of the widths of these three tributaries of the Mer de Glace is 2,597 yards. Now, all of these three tributaries of the Mer de Glace are squeezed into a space, which measures only 893 yards,— a channel only one-third of the width of the sum of the three tributaries. Now it is one of the wonderful properties of this ice that it can be thus squeezed into a narrow bed. If we take a number of stakes and set them in a perfectly straight line across this channel, and allow them to remain there for a day, and observe their position on the following day, we shall find that they are no longer in a straight line. In the observation that was made there were no fewer than 16 stakes fixed in the ice in a straight line. The stakes nearest one side of the glacier moved at the rate of 7 inches in a day; the next stake moved at the rate of 8 inches—the next 13 inches—the next 15 inches—the next 19 inches, and the next 20 inches; and then the speed began to fall off, and fell back to 15 inches at the other side of the glacier. These numbers prove a fact which is also observed in the case of rivers—that the middle of the line moves more quickly than the sides. In the same way, as was proved by Principal Forbes, the top of the glacier moves more quickly than the bottom, or the part nearest its bed, which is held back by the friction of the bed. When I visited the Mer de Glace in 1857 there was a precipice of ice, and I measured the motion of that precipice at the top and at the bottom. The top stake moved 6 inches, while the middle stake moved 4½ inches, and the bottom stake moved 2½ inches. This shows that the top of the glacier moved more quickly than its foot. Furthermore—and this is a point of great importance—if you had a river flowing through a straight valley, the middle of the river would be its point of quickest motion; but if you had a river flowing through a valley of this kind (Fig. 4) the point of quickest motion would be always that point where it is curved. It is exactly the same with a glacier. This on a large scale will represent the bed of the Mer de Glace from actual measurement. At the parts A A the point of swiftest motion is really the centre of the glacier. Here, again, at *a* and *c*, the point of swiftest motion is on one side of the centre. Here, again, at *b*, it crosses to the other side of the centre. The dotted line is the centre, and the continuous line marks the points of the quickest motion on the Mer de Glace.

Fig. 4.



Now, how is it that a glacier is thus able to behave as a river? We will see. I will now cut two pieces from this block of ice. We see that the ice is now melting in the atmosphere of this room, and there is no surplus cold in it to enable it to freeze again; and still, strange to say—(and this was the observation that Mr. Faraday made)—if we place those pieces of ice together, though the surfaces are now melting, they instantly freeze together. Although there is no surplus cold in the ice, the mere bringing them together causes the film of water, which a moment ago was moisture, to become ice. This curious freezing together has received the name of "regelation," a term for which those who first worked at the subject were indebted to Dr. Hooker. In consequence of this freezing together you can actually convert snow into ice. Every boy knows the state of snow which is fit for a snowball. It ought to be soft, and yet by proper pressure you can make it perfectly hard if you are wickedly inclined. Now, I have no snow here, but I will try and obtain snow by scraping the surface of the ice. In this way I get a kind of snow, and here is a flannel in which to receive it. I will take this snow and put it into a proper mould C D, and squeeze it together. In the absence of real snow I make the snow required for the experiment by crumbling the ice in this way. I will now make a snowball, and I am enabled to do this by the power which the small particles of ice have of freezing together in the manner I have just indicated. I cannot by my hand squeeze strongly enough the mould containing these particles of scraped ice; and therefore I will place the mould under the hydraulic press, as this machine is called. In this way I hope to obtain a snowball. [The operation described was then

Fig. 5.



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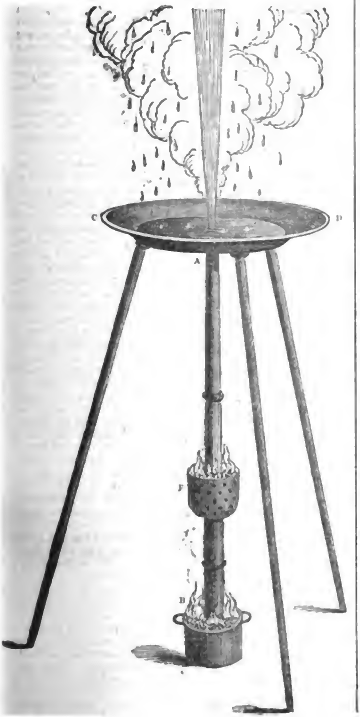
[*] Reported verbatim, by permission of the Author, for this journal.

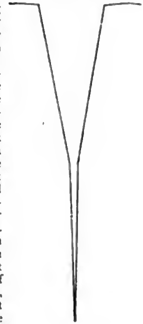
performed, and the mould, on being withdrawn from the press, was found to contain a ball of solid ice.] Now, here we have a snowball (B), such as you have never seen before, and this is due to the fact that on bringing the surfaces of the little particles of ice in contact they freeze together. This is not an ordinary snowball at all, and it is one which no boy would like to be hit with. It is a ball of solid ice, produced from the small particles which have frozen together in virtue of this wonderful property called regelation; and it is in virtue of this property that ice on the surface of water, though shattered into pieces, will mend itself; and all the tearings and ruptures of the glaciers are mended by means of this quality of regelation which was discovered by Mr. Faraday. I have here several experiments arranged to illustrate this subject. [Particles of scraped ice were then moulded into the form of rings and hemispherical cups, by the same means as had been employed in the production of the solid ball. Two hemispherical cups were afterwards placed with their edges in contact, when they froze together and formed a hollow sphere of ice.] These experiments will show you on a small scale how possible it is for particles of a substance perfectly brittle to freeze together wherever they touch, on account of the substance possessing the power of regelation. You see that a substance of this character behaves as if it were not brittle at all, and acts like a paste. In this way we might make statuettes, or, in fact, mould the ice into any form we pleased. You might drink out of these cups, and the ice of which they are made would cool the water for you. I am sorry I have not a little cooled wine to offer you from a cup of this kind. (Laughter.) I have made champagne glasses and all manner of things by thus compressing ice. In this way by these small experiments we illustrate and make plain to ourselves those wonderful things that go on among the glaciers of the Alps; and we entirely clear up the difficulty as to how it is that a body so brittle as ice can behave as a viscous body. I must now leave this subject of ice and its properties.

Fig. 6.



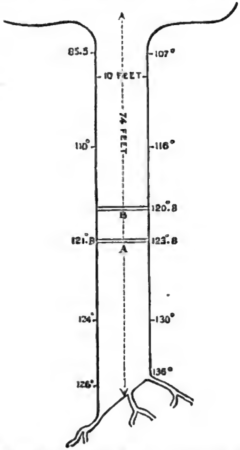
There is in operation before you an apparatus for illsutrating the action of the geysers in Iceland; and in the other room is a beautiful painting of the geysers, presented by our president, Sir Henry Holland, who was there in 1810 with Sir George Mackenzie. In a short time this tube will throw out a column of water, but I do not think I shall be able to make the operation plain to you in this lecture. When Sir Henry Holland and Sir George Mackenzie visited the great geyser, Sir George Mackenzie supposed that the geyser had underneath it a great cavern, and that this was partly filled with water, the geyser itself being a tube. He supposed the water to become heated beneath, and the steam to force the water up into the tube. This is the theory given by Sir George Mackenzie; but it is not at all necessary to suppose the existence of this cavern. The spring itself has built its own tube, and the tube is a sufficient apparatus to produce these wonderful eruptions that astonish everybody who has ever seen them. The geyser tube is represented here in section (see Fig. 8). It is seventy-four feet deep, and is lined with a most beautiful plaster. It opens out at the top into a basin fifty-two feet wide in one direction, and sixty feet wide in the other. [The apparatus for illustrating the geyser was then put in action, and a thick stream of boiling water was presently ejected upwards. (See Fig. 6)]. Now I must make another eruption for you. I want to produce an imitation of the spring called the strokkur (shown in section at Fig. 7). This is a very celebrated spring which you will see in Sir Henry Holland's painting beside the real geyser. (I must explain in the next lecture how it is that we have two fires in this apparatus.) It is usual for the natives of Iceland to stop the mouth of the strokkur by throwing in clods. I will now imitate that practice by putting in a cork at the end of the tube. In a short time the cork will be ejected, and I should not be at all surprised if the water reached the ceiling. I think the last experiment made at the strokkur was made by Commander Forbes. He wrapped a leg of mutton in a towel and stopped the mouth of the strokkur by means of that leg of mutton. The leg of mutton came out well cooked, and was projected to a great height in the air. Various people have estimated the height of

Fig. 7.



these eruptions in Iceland. Sir Henry Holland tells me that he saw one of more than one hundred feet; and Sir George Mackenzie gives ninety feet as the height of the eruption. The earlier observers made the height very much more. Two Danes, named Aulafsen and Paulson, who were the first to observe the height, state that the geyser pitched its water to a height of 360 feet. Two observations, which may be regarded as perfectly trustworthy, were made by Bunsen, of Heidelburg, and the height was measured by a theodolite. In the last of these observations, which was made on the 16th of July, 1841, the height was estimated at 162 feet, and we may rely upon this observation as being accurate. Now, as I have said, the tube of the geyser is the cause of the eruption; and when we see an eruption produced by a small tube, as in this model, we may regard it as proved that it alone is a sufficient cause, and that there is no need for the supposition that there is a cavern underneath. Bunsen suspended thermometers at various depths below the basin of the geyser to ascertain the temperature of the water. I have marked on this diagram the various temperatures which he found at different depths. At the top the temperature was 8·45° C., and extended to 126·5° C. as the depth increased. Now, how is it that the water does not boil in the geyser when the temperature is over 100° C.? Every boy here will be able to tell me that it is because the water at that depth has to bear not only the pressure of the atmosphere, but also of the mass of water which is above it in the tube. For this reason it cannot boil at the temperature which Bunsen ascertained. At the depth at which the water in the geyser was found to have a temperature of 126·5°, the boiling temperature would be 136°. At no point does the temperature of the water reach the boiling point for the pressure to which it is subjected.

Fig. 8.



[At this stage of the lecture the cork flew from the mouth of the model of the strokkur, and a copious stream of boiling water was projected to the ceiling of the theatre.]

I must defer the explanation of the action of geysers until the next lecture.

DR. LETHEBY ON FOOD.

Lecture I.

(FROM OUR OWN REPORTER.)

On Monday evening, the 20th instant, Dr. Letheby, at the rooms of the Society of Arts, John Street, Adelphi, delivered the first of a series of four lectures "On Food." The Chairman—W. Hawes, Esq. President of the Society—having briefly introduced the lecturer as "our best authority on the subject about to be illustrated," Dr. Letheby commenced his lecture by observing that the economy of food was a subject of national importance; that muscular strength was co-equal with the amount and quality of food taken into the body; and that calamity and actual want, the absence of proper diet, the neglect of protection against weather, and disordered sanitary appliances, fell heaviest upon those least able to bear the burden. Bad, however, as the immediate consequences are, they are nothing to the sickly race which comes afterwards. We must not overlook the nutritive value of our raw materials of foods, and we must therefore endeavour to erect a standard of comparison between different articles. The erecting this standard is a subject of the greatest difficulty. First, where some article may be considered without any other—milk or bread for example. Then the difficulty is that the proportions of these several constituencies differ in a great degree from the constituents of most other articles by certain different proportions of the several constituents. Again, as nitrogenous matter in food is the most important object, chemists ask how much nitrogenous matter is there in any given article of food? But even this test was not correct, even though it bore the support of Liebig, for upon his principle that an adult must take into his frame per diem 1,200 grains of nitrogenous matter; provided that he lived solely on beer or porter, he would have to drink 180 pounds of the said liquid to make up the required number of grains. The question now comes, what is the exact relative proportion of nitrogen and carbon necessary to sustain man without much labour. Dr. Lyon Playfair has sought in our workhouses, Dr. Edward Smith amongst the Lancashire weavers, to see the minimum a person can exist upon. Dr. Lyon Playfair says 4,100 grains of carbon to 190 grains of nitrogen; and Dr. Edward Smith (who observed the Lancanshire weavers just at the point when the food was failing to support life), that the proportion an adult woman required was 3,900 grains of carbon and 180 grains of nitrogen; whilst for an adult man 4,300 grains of carbon and 200 grains of nitrogen were required; the average of which is 4,100 grains of carbon and 190 grains nitrogen (thus agreeing with the statement of Dr. Lyon Playfair), contained in two pounds three ounces of bread. This statement almost agrees with another set of observations taken on a different principle; but as regards the chemical properties of the nutritive value of food, it may be convenient to observe that the relative proportions of the two in any article must be as 100 of carbon to 5½ of nitrogen.

I will now proceed to take a glance at the various kinds of food, first of all remarking that there is no such thing as animal food, but that all food, directly or indirectly, belongs to the vegetable kingdom. Animals have no power to construct food; their functions, instead of building up, pull down food, and although therefore whilst we are eating meat we may say we are eating animal, yet indirectly we are eating animal food; and it is with this primary idea that all food belongs to the vegetable kingdom that I commence my review of the raw materials of food.

Wheat is the first and the most important. There are two kinds, the summer and the winter wheat. Seasons, soils, and climates affect the quality of the crop; the warmer the weather, the richer the grain. Here (pointing to the wall) is a diagram showing the construction of wheat. A cone, the outer covering of which is composed of fibrous and woody matter, in the interior of which a farina peculiar in its form is to be observed. There are various kinds of wheat, the best white tails, fine pollards, coarse pollards, and bran; and although taken per bushel the bran is the cheapest, yet taken as per 20 lbs. it is found to be dearer than many shades superior quality. Dr. Letheby then went into the details of the chemical composition of wheat, showing that it was composed upon a principle which made it a most wholesome food, stating that the relative proportions of nitrogen and carbon were as 1 of the former to $6\frac{7}{10}$ths of the latter. He also observed that whilst the best wheat was made into flour, he thought there was a fact which proved that the coarser kinds were rather too much neglected, for, in proportion as we went lower down the scale in coarseness it was found at the same time that the quantity of nitrogenous matter increased in a large degree. Dr. Letheby then successively went through the various kinds of grains, barley, oats, rye, maize, rice, showing in each case the chemical composition which indicated their respective nutritive values; showing the reasons that they either possessed no gluten, or else too much fat—why it was impossible to make them into bread; showing also, as in the case of rice, that a combination with some substance containing a great amount of nitrogenous matter was required to make them palatable; passing to a consideration of succulent vegetables, devoting some space to the consideration of the potato, stating what an effectual remedy it was against scurvy, and saying a few words respecting the other well known vegetables; then proceeding to a brief consideration of fish food; and turning his attention lastly to animal food, referred to the preference given by the poorer classes to bacon instead of butcher's meat, for the reason that it was cheaper to buy, easier to keep, was easier to cook, and less of it wasted away during this operation, and possessed a greater relish; concluding by observing that whilst the large amount of provisions that were required to feed near upon three millions of souls, were brought almost to our very doors with the regularity of clock-work, that this regularity was effected not by Governmental help nor municipal interference, but by the mighty influence of free trade.

Loud and prolonged applause greeted Dr. Letheby at the close of his lecture, and he informed his audience that the very perfect specimens by which he had illustrated his lecture had been kindly lent him for the occasion by Mr. Twining from his Economical Museum at Twickenham.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, January 16.

Dr. Warren de la Rue, F.R.S., &c., President, in the Chair.

The minutes of the previous meeting were read and confirmed. Messrs. G. W. Child, Edward Chapman, W. G. Mason, P. Griess, and Captain Alexander Walker were duly elected.

Mr. Martin Murphy, of the College of Chemistry, Liverpool, was proposed for election, and the certificate read for the first time. The names of the candidates read for the second time were—Herbert M'Leod, Thomas Charlesworth, Robert Schenk, and John Wallace Hozier.

A paper on the "*Isomeric Forms of Valeric Acid*," by Mr. Alexander Pedler, was read by the Secretary.

The author separated the two varieties of amylic alcohol known as active and inactive, by conversion into baric sulphamylates, and fractionally crystallising. The amylic alcohol was then separated from these salts. By oxidation, valeric acid was obtained from the two varieties. The valeric acid yielded by the inactive variety (*i.e.*, that resulting from the further treatment of the less soluble sulphamylate) boiled at 175° C., and had no action on a polarised ray. The valeric acid yielded by the rotating alcohol (separated from the soluble sulphamylate) boiled at about 170° C. It rotated the ray 43° to the right.

Dr. Debus advanced some hypothetical views concerning thioformic acid—the acid which is obtained in combination with lead, when formiate of lead is treated with sulphuretted hydrogen. It contains the elements carbon, hydrogen, sulphur, and oxygen. Dr. Debus referred to the inability of Professor Limpricht and Mr. Herst, who have analysed this substance, to obtain concordant results. He showed that a relation might be traced in the analytical results between the carbon and the hydrogen, while in the case of the sulphur and oxygen there was an utter absence of this. But if the numbers of the sulphur and oxygen were added together they then gave figures bearing constant relation to the carbon and hydrogen. Dr. Debus gave the following formulæ as the expression of the analytical results obtained for two specimens :—

$$(1.)\ CH_2O+2(CH_2S).$$

$$(2.)\ CH_2O+3(CH_2S).$$

Dr. Frankland's lecture "*On Water Analysis*" followed.

Dr. Frankland said—"Having for some time past been engaged, in conjunction with my late pupil, Mr. Armstrong, in endeavours to place some of the determinations of water analysis upon a sounder basis, I proposed to give the results of our experiments to the Society in the usual form of a paper, when our indefatigable senior Secretary suggested that the paper should be elevated to the rank of a lecture. To this suggestion I was at first much opposed, considering that the Society had already, and even quite recently, received several important communications on this branch of chemical analysis. At last, however, I yielded to Dr. Odling's persuasion, but, in doing so, distinctly cast upon his shoulders the responsibility of summoning the Fellows to hear, under the title of a lecture on water analysis, what I fear will merely prove a dry communication on a few points only connected with this large subject; for, in the first place, I have no intention of discussing the whole subject, but only that portion of it which deals with those determinations comprehended under the term 'partial analysis of a water;' and secondly, even in reference to this corner of the subject, I have, except in one department of it, little that is novel to bring forward. So many difficulties surrounded the subject at the time this investigation was undertaken, that it was perhaps considered the least satisfactory of analytical processes. The difficulty chiefly experienced by water analysts was the determination of the organic matters and the mineral products derived from these, viz., nitrous and nitric acids and ammonia." The lecturer mentioned the names of Hofmann and Blythe, Weltzien, Dr. Miller, and Dr. Angus Smith, and the ways in which they had severally contributed to the improvements of the analytical processes regarding water. The determinations usually made in the partial analysis of a water are—*a.* The total solid constituents. *b.* The organic and other volatile matters. *c.* The oxygen required to oxidise organic matter. *d.* The nitrous and nitric acids. *e.* The ammonia.

These processes were considered *seriatim.*

(*a.*) In the method usually adopted for the determination of the total solid constituents—the evaporation of the water with addition of sodic carbonate and drying at 120° to 130° C.—there are two prominent sources of error; firstly, the salts of ammonia are converted into carbonate, which volatilises during the operation; secondly, urea when present is decomposed, and some of the products are volatilised. In an experiment made to test this point

44 per cent of urea was lost. These defects are lessened by not adding the alkaline carbonate, and by drying at 100° instead of at 120°—130°. A residue dried at 100° sometimes retains the elements of water, but these are chemically combined, and the amount obtained can therefore be fairly considered as representing only the solid constituents. With the exception of water containing much calcic and magnesic chlorides and sulphates, the difference made by drying at the one temperature or the other is not great. A water analysed (Thames water) gave as the total amount of solid matter in 100,000 parts, 27·02 parts when dried at 100° C.; and 26·54 parts at 120°—130°C.

Dr. Frankland did not, however, consider the information afforded by this determination as great. In estimating the loss upon ignition, suffered by this residue, it must be previously heated to the higher temperature.

(*b.*) In the determination of the volatile matter by the loss upon ignition, the magnesic and calcic carbonates are causticised, and have then to be recarbonated. In this operation all the organic matter cannot be expelled, —notably the case with water containing urea. Experiments were made with water containing known weights of urea and sodic carbonate. In three experiments only 14·6, 28·2, and 42·1 per cent respectively became expelled; 85·4, 71·8, and 57·9 per cent remaining in the residue in these cases. Dr. Frankland suggested the possibilty of some of the elements of the urea being fixed in the condition of cyanate and cyanurate. A remarkable error is introduced in the case of some waters in recarbonating the alkaline earths, even with a pure solution of carbonic anhydride, the apparent amount of earthy carbonates being greatly in excess of the real amount. In such a case of course the process cannot be used.

(*c.*) Estimating the amount of oxygen required to oxidise organic matter. Potassic permanganate has been commonly used in making this determination. A close examination of the process, however, has led to its indications being found unreliable. In experiments made upon nine kinds of organic matter, only one, oxalic acid, was completely oxidised in six hours. In the case of urea, hippuric acid, and creatin, the oxygen, abstracted from the permanganate, only represented $\frac{1}{50}$th of that required by theory.

(*d.*) Estimation of the nitrous and nitric acids. In this determination, Pew's process has been much used. It turns upon the conversion of stannous chloride into stannic chloride in the presence of nitric acid. Messrs. Chapman and Schenk have pointed out that this change is effected by many organic substances.

The lecturer recorded experiments upon this subject, which showed that the indications obtained in treating starch and sugar by this process were incorrect. 1 grm. starch digested for 20 minutes in a sealed tube with 3 c.c. of a solution of stannous chloride produced an oxidation equivalent to ·00375 grm. nitric anhydride; ·1 grm. sugar at 150° C. produced an oxidation equivalent to ·007 grm. nitric anhydride.

(*e.*) Estimation of the ammonia. This is usually effected by distilling with baryta water or sodic carbonate, and determining the ammonia either by neutralisation or by Nessler's test. It is liable to give inaccurate results in the case of waters recently contaminated with sewage, owing to the gradual decomposition of urea. Dr. Frankland in describing the processes and modifications he proposed to substitute, divided the water analysis into four, viz. the following determinations:

1. The total solid constituents.
2. The organic carbon and nitrogen.
3. The nitrogen in the form of nitrates and nitrites.
4. The ammonia.

(1.) *Estimation of the total solid constituents.*.—For this purpose ½ litre of water is evaporated as rapidly as possible, and the residue dried at 100° C.

(2.) *Estimation of the organic carbon and nitrogen.*—The lecturer had no process to offer for the direct determination of the organic matter, but he was able to estimate the carbon and nitrogen, which were its most important elements, with accuracy. It is necessary in the first place to expel the carbonic anhydride. Sulphuric acid has been found to effect this easily, and for many reasons it has been found the most convenient acid. The solution is boiled for a couple of minutes with a small quantity of sulphuric acid and then evaporated; for this purpose hemispherical glass dishes have been found far more convenient than platinum. The evaporation is conducted in vacuo, and the residue dried at a steam heat. The heat is applied at the *top* of the bell, by means of a current of hot air; applied in this way the water never boils. Five samples of water could be evaporated at the same time in the apparatus shown to the Society.

The residue is mixed with plumbic chromate and transferred to a combustion tube, the dish being rinsed with the chromate; a layer of pure cupric oxide is also added. The tube is sealed at one end and drawn out at the other to about the same size as the tube of the Sprengel's pump which it has to join. The anterior portion of the tube (the position of the layer of pure cupric oxide) is heated, and the tube then exhausted for 5 or 10 minutes. The combustion is now made, and the tube again exhausted, and the resulting gases collected over mercury.

A gaseous mixture is obtained, containing free oxygen. After absorbing the oxygen by pyrogallic acid, the volume of the gaseous mixture is accurately measured. The whole of the carbon is obtained in the form of carbonic acid, the nitrogen partly as such, with nitric acid and nitric oxide. The amount of nitrogen found is made up of the nitrogen of the ammonia and the organic nitrogen; the former must therefore be subtracted.

Cupric oxide made from nitrate is not admissible. It is best obtained by oxidising sheets of copper. It may be obtained tolerably pure from blue-vitriol makers. In experiments made upon solutions of known weights of sugar treated by the whole process these results were obtained:—

	Found.	Calculated.
Carbon	·01306	·01460
	·00440	·00480
	·00530	·00510

A solution of a known weight of sugar and chloride of ammonium gave—

	Found.	Calculated.
Carbon	·00434	·00484
Nitrogen	·00254	·00246

Dr. Frankland had examined Messrs. Wanklyn, Chapman, and Smith's method of estimating the albuminoid nitrogen in water. Numerous experiments were made side by side with the combustion process now brought forward. These are some of the results obtained in samples of water artificially made, representing water of average quality:—

Permanganate Method.	Combustion.
·006	·010
·002	·010
·016	·068
·016	·042
·022	·076

Where the quantity was small they agreed better.

·001	·001
·004	·009
·003	·004
·012	·012

The permanganate method in several cases gave nitrogen where the combustion process showed none.

(3.) Estimating the nitrogen in the form of nitrates and nitrites, Dr. Frankland has found a process devised many years ago by Mr. Walter Crum, to give very good results.

A concentrated solution of the nitrate or nitrite is mixed with rather more than an equal volume of sulphuric acid and agitated with mercury in as finely divided a state as possible. It is convenient in this operation to use the residue obtained in the determination of the total solid constituents. Chlorides must not be present. To remove chlorine, argentic sulphate is added to the residue dissolved in 15 or 20 c.c. of water, the solution filtered, and evaporated to a small bulk. It is then transferred to a vessel standing over mercury. The vessel may be described as a narrow eprouvette drawn out at the top into a narrow tube with a stopcock, carrying above a cup-shaped piece. The last portions of the fluid are washed in with the acid itself. The tube has been filled up to the tap completely with mercury, and care is necessary in allowing the descent of the fluid from the cup to the lower vessel to allow no air to enter the latter. The tap being carefully closed, the thumb is slipped under the end of the tube, which is then withdrawn and shaken. In this operation a short column of mercury must always remain between the thumb and the solutions. A strong pressure is produced, and the tube is occasionally returned to the trough, and the egress of some of the mercury permitted. The pressure is due to the formation of gaseous oxides of nitrogen. The nitrogen is determined in the resulting gas. The reduction of the nitrates and nitrites by this means was shown to the Society, the process described being performed experimentally, and a considerable quantity of gas was obtained.

This process has been tried with known quantities of nitre, also with uric and hippuric acids, and found to give satisfactory results.

(4.) Determination of the ammonia. Dr. Frankland considered it advisable to decolorise the water before using Nessler's colour test, using for this purpose calcic chloride, sodic carbonate, and a few drops of potassic hydrate. The distillate from this gave accurate indications.

The **President**, in returning the customary vote of thanks, took occasion to inquire whether the reduction of the nitrates was carried to nitrogen.

The subject being evidently a fertile one for discussion, the speakers were limited to a few minutes each.

Mr. **Wanklyn** wished to know whether the comparative experiments with the process devised by himself and colleagues were made with natural or artificial waters. He maintained that their process gave constant results with from 1 to 6 parts of albumen in 100,000 of water.

Professor **Abel** had thought the process alluded to by the last speaker might have been serviceable to him, and had instituted experiments to check their results. He had been totally unable to obtain concordant results.

Mr. **Dugald Campbell**'s experience with the process was similar to Professor Abel's.

Mr. **Chapman** attributed the different results obtained by Dr. Frankland by the combustion process and their process, to sources of error in the former.

Mr. **Thorpe**, calculating the nitrogen as albumen, obtained results agreeing with other determinations, and found the process valuable as a method of controlling his results.

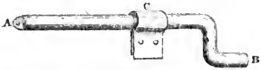
Dr. **Vœlcker** remarked that M. Nessler had told him of a simple method of separating the ammonia when present in moderately large quantity. The Nessler test, shaken in a bottle with the water, gave a precipitate which contained all the ammonia. By separating this by deposition, and treating it with sulphide of potassium, and distilling, all the ammonia will be separated, and may be collected in a solution of standard acid.

Mr. **Smee** and Mr. **Hawksley**, the engineer, also took part in the discussion.

The lecturer replied to the many remarks that had been made. The question put by the President was one of great interest, but he was unable to say definitely whether the reduction was carried to nitrogen. He should act upon the point suggested by Dr. Vœlcker. At a late hour the Society adjourned. Mr. Wanklyn wished to continue the discussion, and he therefore possesses the right to speak at the commencement of the next meeting.

NOTES ON LECTURE EXPERIMENTS.

Preparing Coils of Wire.—I have found the following simple apparatus extremely serviceable in preparing coils of steel wire for combustion in oxygen, and for coiling wires for battery connections. The apparatus was devised by Mr. Waite, of this town:



A B is a rod of iron of the diameter it is desired the coils shall be made. The extremity A is flattened, and a hole drilled through, while the other end is bent twice at right angles to form a winch. C is a piece of sheet iron bent so as to fit loosely round the bar, and when the lower part is fastened in a vice, serves as a support for the rod A. B. To prepare a coil of wire, the lower part of the support C is clamped in a vice; a long piece of this wire is then threaded through the hole at the extremity A, and the two ends held while an assistant turns the winch. The wire when twisted is held against the bar with the left hand, while the winch is turned with the right, and the wire is thus wound on the rod. On cutting the wire at A, the coil may be removed, and is ready for use.

C. J. Woodward.

Midland Institute, Birmingham, January 6th, 1868.

CORRESPONDENCE.

ANTISEPTICS.

To the Editor of the Chemical News.

Sir,—I have for some time been a reader of your journal, and frequently find therein articles which interest me as a manufacturer. There is one subject upon which I am anxious to obtain practical information in which I am directly interested, and which is seldom spoken of in works relating to organic chemistry, at least in any works which it has been my fortune to consult; I allude to the subject of antiseptics. Can you point, for instance, to any rule, by an acknowledged authority, which defines the quantity of any chloride, say of mercury, zinc, &c., which, when in solution, will, with certainty, protect from mould or other change, whether produced by a change of climate, a moist atmosphere, warmth or cold, another given quantity of material which contains a large proportion of nitrogenous matter, such as mucilage, &c.; and is there any other antiseptic more active or certain in its preservative properties than the substance named, which is equally economical, and which can be used advantageously in an extensive business where considerable quantities would be required? If you can afford me practical information on this subject, or direct me where to find it, you will confer a favour, and much oblige,

A Constant Reader.

Philadelphia, Penna., U.S., Dec.

[Carbolic acid or (if the odour be an objection) oil of cloves will produce the desired effect. About one part in 1,000 will, in ordinary cases, be sufficient.—Ed. C.N.]

HYDROUS, NOT HYDRATED.

To the Editor of the Chemical News.

Sir,—Most writers on modern chemistry regard hydrates as altogether distinct from what they call hydrated substances, yet retain the respective names, to the great risk of confusion; a hydrate is stated to be a body containing hydroxyl (HO), a hydrated substance one containing water (H_2O). Why not let the word "hydrated" follow its parent, and relate to hydrates only? Salts without water are appropriately spoken of as anhydrous, salts with water may surely be termed hydrous. I should, for instance, consider the body having the formula Mg_2HO as a hydrate, that having the formula $MgCO_3, 3H_2O$ as a hydrous carbonate, not a hydrated carbonate.—I am, &c.,

John Attfield.

DETECTION OF OZONE.

To the Editor of the Chemical News.

Sir,—During the past year I have on several occasions exposed moistened silver-leaf to the atmosphere, with a view to determine how far it might be used as a trustworthy test for ascertaining the presence or absence of ozone.

Whenever the ordinary test (potassic iodide and starch) indicated that ozone was present, some part of the silver-leaf was oxidised, and the greater the amount of ozone, the quicker was the oxidation of the silver effected.

The silver-leaf was exposed freely to the atmosphere, and was kept moistened by causing distilled water to pass over it, the water being conducted from an adjacent vessel by two or three threads of common darning cotton.

By observing the time which elapses before the silver-leaf is oxidised, an idea may be formed of the relative amount of ozone present on any given day.—I am, &c.,

R. C. C. Lippincott.

Bournemouth, Jan. 13.

MISCELLANEOUS.

New Scientific Club.—We have received information of the establishment of a scientific club in Dublin. This club is not intended as a channel for the promulgation of original matter, but is simply designed to give to the members that early information of advances made by others in science, which in London springs from the unorganised conversation of the learned societies. It is proposed to deal with one group of sciences—the group of physical sciences, including physics, chemistry, and the applications of mathematics to physics as in astronomy, mechanics, electricity, &c.; but excluding pure mathematics on the one hand, and physiology, geology, and the other natural sciences on the other. The number of ordinary members is limited to twenty-five, but visitors are to be freely admitted by members' introduction. The annual payment for an ordinary member is £1. The scientific men in our provincial towns may take a hint from this Dublin Scientific Club. It will be remembered that a meeting in Glasgow was recently convened to forward the formation of a similar institution there.

Amber.—Recently the local correspondent of a Geelong journal announced the discovery of a supposed amber mine at Rokewood. The Age pooh-poohed the matter, and suggested that the substance was simply a description of gum found in lignite deposits. The author of the statement, as to the substance being amber, has replied, and says:—"I, for one, will confess that I never heard of this sort of gum referred to, except close to the surface of the roots of trees, and certainly not at a depth of 70 feet; but for the benefit of the curious I will give you a *verbatim* copy of the written opinion of a professional mineralogist, who resides at Ballarat, and whose ability and experience in such matters is, I am told, well known there and elsewhere. 'The resinous substance left with me for examination is undoubtedly amber, and has not previously, to my knowledge, been found in this colony; making therefore another addition to our colonial minerals. The colour of the said substance is brown, streaked yellowish white, transparent, conchoidal fracture, lustre waxy. Specific gravity 1·1. Acquires resinous electricity by friction; contains empyreumatic oil and succinic acid, and corresponds in all other respects with the brown amber of Europe. (Signed) A. T. Abel.' I have also been shown the substance obtained from the mine by Messrs. M'Keeman, draper, Ballarat, and Blair, miner, Break o' Day, either of which gentlemen I have no doubt would be most happy to show it to any gentleman interested in the development of our mineral resources. Ths mine, at which men are now employed, is situated at Grassy Gully, about eight miles from Rokewood, in the direction of the Mount Misery Ranges."—*Ballarat Evening Post, July* 4, 1867.

Petroleum for Steamship Boilers in the United States Navy.—After careful and long-continued trials, the Secretary of the United States Navy finally reports against the employment of petroleum as a fuel in steamships. He says:—"The act approved April 17, 1866, appropriated five thousand dollars for testing the use of petroleum as a fuel for marine boilers. An elaborate series of experiments has been made at the New York and Boston Navy Yards. The conclusion arrived at is that convenience, comfort, health, and safety are against the use of petroleum in steam vessels, and that the only advantage thus far shown is a not very important reduction in bulk and weight of fuel carried."

Lead Floating on Molten Iron.—Some experiments have been made in Germany which seem to show that molten lead when dropped upon liquid iron remains floating on the surface of the latter. As the specific gravity of lead (11·5) is more than one-half greater than that of cast-iron (7), there arose some discussion on this subject, which has been recently closed in a very satisfactory manner by the researches of Professor Karmarsch, of Hanover. An iron-master in the vicinity of that town had sent to the Professor some samples of such drops of lead lying imbedded in the surface of a cast-iron block, and which had been produced in the manner above described. Professor Karmarsch found, upon close examination, that these drops of lead, instead of being solid globules, as was supposed at first sight, were all found to be hollow, forming bubbles composed of metallic skin, and apparently empty in the centre, so far as his observation was carried. He explains the whole by supposing that the molten lead, at the temperature to which it is raised by the contact with the liquid iron, forms an incipient vapour of lead, which is prevented from escaping by the skin of solidifying metal which forms on the top. The lead vapour, according to this explanation, keeps the lead resting upon the surface of the iron. It seems that in large quantities the result is different, since it is known that lead is occasionally tapped from the bottom of the blast furnaces which smelt certain classes of ores containing lead, and in these cases the lead is found below the liquid iron according to its greater specific gravity.

Tyrian Purple.—The Tyrians were probably the only people of antiquity who made dyeing their chief occupation, and the staple of their commerce. The opulence of Tyre seems to have proceeded, in a great measure, from the sale of its rich and durable purple. It is unanimously asserted by all writers that a Tyrian was the inventor of the purple dye, about 1,500 years B.C., and that the king of Phœnicia was so captivated with the colour, that he made purple one of his principal ornaments, and that, for many centuries after, Tyrian purple became a badge of royalty. So highly prized was this colour, that in the time of Augustus, a pound of wool dyed with it, cost at Rome a sum nearly equal to thirty pounds sterling. The Tyrian purple is now generally believed to have been derived from two different kinds of shell-fish, described by Pliny under the names *purpura* and *buccinum*, and was extracted from a small vessel or sac in their throats to the amount of one drop from each animal; but an inferior substance was obtained by crushing the whole substance of the *buccinum*. At first it is a colourless liquid, but by exposure to air and light it assumes successively a citron yellow, green, azure, red, and, in the course of forty-eight hours, a brilliant purple hue. If the liquid be evaporated to dryness soon after being collected, the residue does not become tinged in this manner. These circumstances correspond with the minute description of the manner of catching the purple dye fish given in the work of an eye-witness, Eudocia Macrembolitissa, daughter of the Emperor Constantine the Eighth, who lived in the eleventh century. The colour is remarkable for its durability. Plutarch observes, in his life of Alexander, that, at the taking of Susa, the Greeks found, in the Royal treasury of Darius, a quantity of purple cloth, of the value of five thousand talents, which still retained its beauty, though it had lain there one hundred and ninety years. This colour resists the action even of alkalies, and most acids. Pliny states that the Tyrians gave the first ground of their purple dye by the unprepared liquor of the *purpura*, and then improved or heightened it by the liquor of the *buccinum*. In this manner they prepared their double-dyed purple—*purpura dibapha*—which was so called, either because it was immersed in two different liquors, or because it was first dyed in the wool and then in the yarn.—*Prof. Dussance.*

CONTEMPORARY SCIENTIFIC PRESS.

Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Annalen der Chemie und Pharmacie.
September, 1867.

O. Loew, "On Sulphonaphthalic Acid." G. Wischin, "On Phenylenediethylacetone and Ethylenediethylacetone." F. Gauhe, "On Sulphurous Cyanide and other Decomposition Products of Sulphurous Chloride." O. Rembold, "On Quino-tannic and Quinova-tannic Acids." A. Grabowski, "On Rhatania-tannic Acid." G. Malin, "On Filico-tannic Acid." A. Grabowski, "On Filicic Acid." O. Rembold, "On the Tannic Acid of the Root Bark of the Pomegranate Tree." H. Hlasiwetz, "On the Relations between the Tannic Acids, Glucosides, Phlobaphenes and Resins." L. Carius, "On Chlorous Anhydride and Benzol." C. Glaser, "Researches on some new Derivatives of Cinnamic Acid." E. Linnemann, "On the Transformation of the Bromides of the Hydrocarbons belonging to the the Series C_nH_{2n} into Acetones of the Fatty Acids containing the same Quantity of Carbon." W. Heintz, "On Phosphate of Zinc and Phosphate of Zinc and Ammonia." C. O. Cech, "On a new Method of forming Viridic Acid." F. Beilstein, "On the Behaviour of Toluol towards Bromine." A. Gescher, "On Sulphide of Copper and Ammonium."

Bulletin de la Société Chimique de Paris.
September 1867.

E. Junofleisch, "On some Mutual Relations between the Melting Points, Boiling Points, Densities, and Specific Volumes of some Chlorinated Derivativss of Benzene." C. Friedel and A. Ladenbuao, "On a Bromide of Propylene derived from Acetone." D. Gernez, "Resumé of the Author's Investigations on Supersaturated Solutions." C. Marionac, "On an Analysis of Æschynite." "On the Separation of Niobic from Titanic Acid."

Memoires de la Société des Ingenieurs Civils de Paris.
January—March, 1867.

Limet, "Analysis of a Specimen of Boiler scale." Simonin, "On the Coal Fields and Mineral Veins of the Old and New World." E. Flachat, "On the same subject." E. Flachat, "On the Speciemn of Boiler Scale exhibited by Limet." Farcot, Limet, Tresca, on the same subject. Rinail, "On the Use of Caustic Soda for preventing the Formation of Boiler Scale in Locomotives." Foucou "Note on the Deposits of and Modea of obtaining Petroleum in North America, together with some Account of the Theories which have been proposed to account for its Origin." W. Clarke, "On the Modes of obtaining Petroleum in America." A. Morin, "Report on Technical Education." Delonchant, "On the Use of Plates of Mica for indicating the various Planes in Models for teaching Descriptive Geometry." Arson, "Analysis of a Deposit from a Feed-water Heater." Flachat, "Note on some Spherical Concretions found in the Boilers of the Transatlantic Steamer "Ville de Paris."

Mittheilungen des Gewerbe-Vereins für Hannover.
No. 3. 1867.

Buresch, "On the English Alkali Act, 1863." G. E. Landsberg, "Some Experiments on the Comparative Calorific Power of Piesberg and Ibbenburen Coal." Heeren, on the same subject. Begemann, "On the Official Analysis of Milk." C. Sostmann, "On the Use of Paraffin for checking the violent Ebullition of Syrup in Evaporating and Vacuum Pans." "On the Manufacture of Albumen." R. Niccol, "On the Presence of Microscopic Insects in Raw Sugar." Cameron, Hassal, on the same subject. L. Elsner, "On the Sublimation of certain Bodies at a White Heat."

No. 4.

Ruhlmann, "Improved Processes for the Manufacture of Oatmeal and of Oil." P. Leorand, "An improved Iron Barrel for holding Spirits." H. Violette, "On the Preparation of Copal and other Resins for the Manufacture of Varnish." L. Rinman, "On the Presence of Nitrogen in Steel and Pig Iron, and on the Condition of Carbon in Hard and Soft Steel."

NOTES AND QUERIES.

Determination of free Sulphuric Acid.—I want to determine the free sulphuric acid in superphosphates, and do not quite know how to do it. Is it possible to do it by shaking the solution with oxide of lead and to determine afterwards the sulphate of lead formed? Can any of your correspondents tell me if this plan would do, or can they tell me of another way.—V. C.

To Prevent Water Freezing.—Can any of your readers oblige by answering the following questions? 1. What proportion of salt must be added to water to prevent it freezing, when exposed to the coldest weather known in this country? 2. What percentage of alcohol should water contain for the same purpose? 3. Is there any other cheap substance which would effect the same object, and which would not attack iron?—Volta.

Bleaching Calico.—Your correspondent G. L. desires to receive information relating to "Bleaching Powder Solutions." It is not absolutely necessary to throw away the solutions after you have passed a certain quantity of fabrics through them, unless in the case of very fine goods, or where there are any coloured ornaments in the cloth to preserve; the solution, if it has been kept too long, is apt to injure the fabric or decolorise the ornaments. The usual method for testing solutions of bleaching powder is by means of the sulphate of indigo test. The hydrometer being a very fallacious test, I would recommend your correspondent to make himself acquainted with the chlorimeter test introduced by the late Mr. Walter Crum, and which is so easily manipulated that a workman of ordinary intelligence can easily understand it. The chlorimeter test can, if I mistake not, be procured from Griffin, who I have no doubt will give every information regarding it.—A. G. S.

Detection of Magnesia in the presence of Manganese.—When a compound is perfectly free from magnesia, but contains manganese, together with phosphates insoluble in water, on adding ammonia and hydric disodic phosphate (Na_2HPO_4) a precipitate is almost invariably obtained; this precipitate has very much the appearance of triple phosphate, and might be readily mistaken for it; but analysis shows that it does not contain any magnesia. Its formation is due to MnO being carried down with Fe_2O_3 on boiling with potash; by boiling with chloride of ammonium the MnO is dissolved out; now on treating with Na_2HPO_4 and ammonia, the precipitate in question is obtained, which adheres to the sides of the vessel where it has been rubbed by the rod, in exactly the same manner as the magnesia precipitate. This reaction does not take place if the precipitate containing MnO be exposed to the air for some time, for then it absorbs oxygen, and forms MnO_2, which is insoluble in chloride of ammonium. Mg may be readily detected in the presence of Mn by dissolving the precipitate in HCl, neutralising with ammonia, and precipitating the Mn by means of ammonic sulphide, and again adding Na_2HPO_4 and ammonia, when the Mg will be precipitated, and this may be know to be free from Mn by its not colouring a borax bead.—A. Liversidge.

TO CORRESPONDENTS.

*** Owing to pressure on our space the "Answers to Correspondents" will be given in our next.

Communications have been received from F. C. Calvert & Co. (with enclosure); W. Sugg; E. G. Tosh (with enclosure); Magnesium Metal Co.; E. Cetti; T. H. Rowney (with enclosure); Dr. R. Oxland; J. Heywood; Dr. A Wuth (with enclosure); J. Slessor (with enclosure); R. Talling; R. Rumney (with enclosure); E. D. Day; W. Wilkinson (with enclosure); J. H. Kiel; W. Smith; W. Bailey and Son (with enclosure); J. Hill (with enclosure); E. W. Bartlett; J. Scrivener; H. Hankey (with enclosure); Professor Heaton; J. How; W. Gordon; E. M. Delf; J. Sprague (with enclosure); E. Goodchild (with enclosure); J. Emerson Reynolds (with enclosures); J. Browning (with enclosure); D. Forbes, F.R.S. (with enclosure); Rev. B. W. Gibsone (with enclosure); W. Wood (with enclosure); Archd. Liversedge (with enclosure); C. J. Woodward (with enclosure); Dr. Day; Dr. H. Debus; Dr. Attfield (with enclosure); Dr. Frankland, F.R.S. (with enclosure).

Books Received.—"Inorganic Chemistry," by Charles W. Eliot and Frank H. Storer. Second edition, revised. London: John Van Voorst; "Le Moniteur Scientifique"; "Journal of Materia Medica" "American Gas Light Journal"; "Scientific American"; "Etude Descriptive, Théorique et Experimentale sur les Météorites." Par M. Stanislas Meunier. Paris: Aux Bureaux du Cosmos, 7, Rue Perronet Près la rue des Saints-pères; "A Treatise on Frictional Electricity in Theory and Practice," by Sir William Snow Harris, F.R.S. Edited by Charles Tomlinson, F.R.S. London: Virtue & Co., 1867.

MEETINGS FOR THE WEEK.

Monday.—Royal Geographical, 8½.
Wednesday.—Society of Arts, 8.
Thursday.—Royal, 8½.
—— Philosophical Club, 6.
—— Royal Institution, 3. Professor Tyndall, "On the Discoveries of Faraday."
Friday.—Royal Institution, 8. Rev. F. W. Farrar, "On Public School Education.
Saturday.—Royal Institution, 3. Professor Roscoe, "On the Non-Metallic Elements.

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3359. E. Belknap, Mortimer Street, Cavendish Square, Middlesex, "Improvements in the treatment of the solution of malt for brewing."—Petition recorded November 27, 1867.

3384. J. Baylis, Durdham Down, Bristol. "An improved chemical preparation or compound to be used in preparing mixed textile fabrics for dyeing or colouring."—November 28, 1867.

3388. T. Rose, Oxton, Cheshire, and R. E. Gibson, New Brighton, Cheshire, "An improved mode of treating cotton seed to obtain oil therefrom, and in machinery employed therein."

3389. C. Albisser, Mincing Lane, London, "Improvements in the preparation of sulphate of magnesia, applicable to the treatment of the crude potash, salts of Stassfurt, and the refuse from the manufacture of chloride of potassium."—A communication from J. Vorster, and H. Grüneberg, Cologne, Prussia.—November 29, 1867.

3405. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved mode of and means for clarifying saccharine solutions."—A communication from J. E. Freund, New York, U.S.A.,—November 30, 1867.

3440. J. Gjers, Middlesbrough, Yorkshire, "Certain improvements in the manufacture of cast steel and homogeneous iron."—December 3, 1867.

3463. S. Perkins, and W. Smellie, Gorton, near Manchester, "Improvements in the manufacture of malleable metal of a steely quality, partly from Bessemer 'scrap' or other Bessemer metal."

3469. P. G. L. G. Designolle, Rue de la Seine, and J. Casthelaz, Rue Ste. Croix de la Bretonnerie, France, "Improvements in the manufacture of explosive and fulminating powders."—December 5, 1867.

3473. J. Durrans, Thurlstone, near Penistone, Yorkshire, "An improved material or composition to be employed for covering or coating the interior surfaces of moulds, crucibles, or ducts, previous to their receiving the molten metal in the process of casting, and for other purposes."—December 6, 1867.

3483. R. B. Jones, Nelson Terrace, City Road, Middlesex, and W. Powell, Circus Place, Finsbury, Middlesex, "Improvements for the prevention of incrustation in steam boilers."—December 7, 1867.

3499. L. Rose, Leith, Scotland, "An improved mode of preserving vegetable juices."

3502. C. Martin, Chancery Lane, W. Barrett, and T. S. Webb, Norton, Durham, "Improvements in the treatment and reduction of titaniferous iron ores, and in the manufacture of iron, and in the construction of furnaces to be employed therein."—December 9, 1867.

3517. A. M. Clark, Chancery Lane, "An improved process for the reduction of tin, so as to render it applicable for coating metals and for other puposes."—A communication from E. Cornélis, Boulevart St. Martin, Paris.

CANDLES.—If you do nnt want your candles exclusively for show, but with pleasantness of appearance require excellence of burning, buy "Price's Gold Medal Palmitine," or their "Sherwood Palmitine," or their good old-fashioned "Belmont Sperm," or "Belmont Wax," or their "Best," No. 2," ""No. 3," or "Battersea" Composite," in preference to the finest, and most transparent Paraffine candles. But if you must have the extreme transparency of pure Paraffine, "Price's Paraffine" or their "Belmontine" will give it to you in perfection, and at a more moderate price than is usually charged for any other really first-class Paraffine Candles.

The new toilet soap, "PRICE'S SOLIDIFIED GLYCERINE," containing half its weight of their concentrated distilled Glycerine, should be in general use in every house before the winter comes on, because of its admirable effects in preventing chapping of the hands and face. In every house there ought also to be one of the sealed bottles of their concentrated Distilled Glycerine, known everywhere as "Price's Glycerine," and prescribed by the most eminent medical men abroad as well as at home, as the one only Glycerine for medicinal use whether externally or internally.

PRICE'S FANCY SOAPS of the different sorts usually made are excellent, and command a constantly increasing sale. The "Solidified Glycerine" spoken of above is, however, the one fancy soap to use.

"PRICE'S NEW PATENT NIGHT LIGHTS," for burning in the wide glasses are believed to be the very best Night Lights made. "PRICE'S CHILDS' NIGHT LIGHTS," for burning without glasses, and their different sorts of "CHAMBER CANDLES" are so well-known, and so generally appreciated as not to need any special notice here.

PRACTICAL CHEMISTRY.
Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its Application to MEDICINE, AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from Ten to Five o'clock; on Saturday from Ten till One o'clock; and from October to March on Monday and Friday Evenings from Six to Nine o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses apply to Mr. Henry Matthews, at the Laboratory, 60, Gower-street, Bedford Square, W.C.

Berners College of Chemistry.—Experimental MILITARY and NAVAL SCIENCES, under the direction of Professor E. V. GARDNER, F.E.S., &c.; of the late Royal Polytechnic Institution and the Royal Naval College.
The Laboratory and Class Rooms are open daily.
Especial facilities for persons preparing for Government and other examinations.
Private Pupils will find every convenience.
Analyses, Assays, and Practical Investigations connected with Patents, &c., conducted.
For particulars, &c., apply to Prof. E. V. G., 44, Berners-street, W

Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c.

TO PHARMACEUTICAL AND OTHER STUDENTS.

Mr. J. C. BRAITHWAITE, for thirteen years Principal Instructor in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c., wishes to inform his old Pupils and others that he continues to devote his whole attention to Education. The Session 1867—1868 will commence on the 1st of October, when

Mr. BRAITHWAITE'S Laboratory, which has been enlarged during the recess, will be re-opened at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS meets as usual every Monday and Thursday Evening, at 8 p.m., commencing October 3rd.

The LATIN CLASS for the reading of the Pharmacopœia, Physicians' Prescriptions, &c., every Tuesday and Friday Evening, at 8 p.m., commencing October 1st.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday Evening, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will commence at 10 a.m., October 2nd.

Fee to either of the above Classes Half-a-Guinea per Month; to the Botanical Excursions only. Half-a-Guinea per Eight Lessons, payable in advance. Pupils can enter at any period.

Address, 54, Kentish Town Road, N.W.
Mr. Braithwaite receives a few Pupils to board in his house.

Paris Exhibition Two Gold Medals.

Liebig's Company's Extract of Meat, as distinguished from "Liebig's Extract of Meat," which name is daily more used for all sorts of extracts. Warranted genuine and of perfect flavour by Baron Liebig, whose signature is on every genuine jar. Cheapest and purest stock for Soups, Entrees and Sauces, highly strengthening for Children and Invalids. 1 lb. 14s, ½-lb. 7s 6d. ¼-lb. 4s, 2-oz. 2s, equivalent to 1d. half-a-pint of best beef-tea. Retail, of Fortnum and Mason, all Italian Warehousemen, Chemists and Grocers. Wholesale, of Crosse and Blackwell; E. Lazenby and Sons; John Burgess and Son; Barron, Harveys, and Co.; Barclay and Sons; Burgoyne, Burbidges, and Squire; Wm. Edwards; M. E. Foster; Langtons, Scott, and Edden; S. Maw and Son; G. S. Pedler; T. and H. Smith and Co., London; Duncan, Flockhart, and Co.; John Mackay; H. C. Baildon, Edinburgh; Southall, Son, and Dymond, Birmingham; Wm. Smeeton, Leeds; Raimes and Co., and B. Westworth, Liverpool; all wholesale houses, and of Liebig's Extract of Meat Company (Limited), 43, Mark Lane, E.C.

Methylated Spirits. — David Smith Kidd, Licensed Maker, Commercial Street, Shoreditch, N.E. Also, FINISH, FUSEL OIL, and RECT. NAPHTHA.

Scholl's Patent Platinum Gas Light Perfecter. —Extract from Report by Dr. Letheby:—
"The results have been very remarkable, for they show an average increase of 63 per cent on the illuminating power of the gas. I am of opinion, therefore, that the invention is of great practical value." Price One Shilling each for Fish-tail Burners. To be had retail of Gas-fitters and Ironmongers, and (wholesale only) of JOHN SCHOLL, 41 and 42, Berwick Street, Oxford Street, London, W. Terms on application. N.B.—A specimen sent free on receipt of 12 stamps.

THE CHEMICAL NEWS.

Vol. XVII. No. 426.

ON

HEAT AND COLD;

A COURSE OF

SIX LECTURES*

(Adapted to a Juvenile auditory),

DELIVERED AT

THE ROYAL INSTITUTION OF GREAT BRITAIN,

(*CHRISTMAS*, 1867–8),

BY

JOHN TYNDALL, Esq., LL.D., F.R.S.

Lecture IV.

The Geysers of Iceland (continued).—The mechanical equivalent of heat.—Consumption of heat.

In our last lecture I intended, if time permitted, to explain the action of the geyser of Iceland, but at the end of the lecture I found that the time was insufficient for the purpose; and I promised then to explain this wonderful spring in the lecture of to-day; but when I came to look at the other matter before me I found that it was so abundant that I really could not get the subject of the geyser into it. In order to help myself, therefore, I printed 500 copies of an account of the geyser which I gave in this room 14 or 15 years ago; and I trust each young philosopher present has furnished himself with a copy of this description of the geyser, from which I have no doubt you will understand its philosophy—particularly by the help of your friends—when you read this paper at home, just as well as if I had tried to explain it to you here.

"The surface of Iceland slopes gradually from the coast towards the centre, where the general level is about 2,000 feet above the surface of the sea. On this, as a pedestal, are planted the Jökull or icy mountains of the region, which extend both ways in a north-easterly direction. Along this chain the active volcanoes of the island are encountered, and in the same general direction the thermal springs occur, thus suggesting a common origin for them and the volcanoes. From the ridges and chasms which diverge from the mountains mighty masses of steam are observed to issue at intervals, and where the escape takes place at the mouth of a cavern and the resonance of the cave lends its aid, the sound of the steam is like that of thunder. Lower down in the more porous strata we have smoking mud pools, where a repulsive blue-black aluminous paste is boiled, rising at times into huge bladders, which on bursting scatter their slimy spray to a height of fifteen or twenty feet. From the base of the hills upwards extend the glaciers, and on their shoulders are placed the immense snow-fields which crown the summits. From the arches and fissures of the glaciers, vast masses of water issue, falling at times in cascades over walls of ice, and spreading for miles and miles over the country before they find definite outlet. Extensive morasses are thus formed, which add to the monotony of the dismal landscape. Intercepted by the cracks and fissures of the land, a portion of these waters is conducted to the hot rocks underneath; here meeting with the volcanic gases which traverse these underground regions, both travel together, to issue at the first convenient opportunity either as an eruption of steam or as a boiling spring.

"In the Great Geyser we have a tube ten feet wide and seventy feet deep; it expands at its summit into a basin, which from north to south measures fifty-two feet across, and in the perpendicular direction sixty feet. The interior of the tube and basin is coated with a beautiful smooth plaster, so hard as to resist the blows of a hammer. The first question that presents itself is, how was this wonderful tube constructed? How was this perfect plaster laid on? A glance at the constitution of the Geyser water will perhaps furnish the first surmise. In 1,000 parts of the water the following constituents are found:—

Silica	0·5097
Carbonate of Soda	0·1939
Carbonate of Ammonia	0·0083
Sulphate of Soda	0·1070
Sulphate of Potash	0·0475
Sulphate of Magnesia	0·0042
Chloride of Sodium	0·2521
Sulphide of Sodium	0·0088
Carbonic Acid	0·0557

"The lining of the tube is silica, evidently derived from the water; and hence the conjecture may arise that the water deposited the substance against the sides of the tube and basin. But the water deposits no sediment, even when cooled down to the freezing point. It may be bottled up and kept for years as clear as crystal, and without the slightest precipitate. A specimen brought from Iceland and analysed in this Institution was found perfectly free from sediment. Further, an attempt to answer the question in this way would imply that we took it for granted that the shaft was made by some foreign agency, and that the spring merely lined it. A painting of the Geyser, the property of Sir Henry Holland—himself an eye-witness of these wonderful phenomena,—was exhibited. The painting, from a sketch taken on the spot, might be relied on. We find here that the basin rests upon the summit of a mound; this mound is about forty feet in height, and a glance at it is sufficient to show that it has been deposited by the Geyser. But in building the mound, *the spring must also have formed the tube which perforates the mound:* and thus we learn that the Geyser is the architect of its own tube. If we place a quantity of the Geyser water in an evaporating basin, the following takes place: in the centre the fluid deposits nothing, but at the edges where it is drawn up the sides of the basin by capillary attraction, and thus subjected to a quick evaporation, we find silica deposited; round the edge we find a ring of silica thus laid on, and not until the evaporation has continued for a considerable time, do we find the slightest turbidity in the central portions of the water. This experiment is the microscopic representant, if the term be permitted, of Nature's operations in Iceland. Imagine the case of a simple thermal spring whose waters trickle over its side down a gentle incline; the water thus exposed evaporates speedily, and silica is deposited. This deposit gradually elevates the side over which the water passes until finally the stream has to choose another course; here the ground becomes elevated by the deposit as before, and the stream has to move forward—thus it is compelled to travel round and round, discharging its silica and deepening the shaft in which it dwells, until finally, in the course of centuries, the simple spring has produced that wonderful apparatus which has so long puzzled and astonished both the traveller and the philosopher.

"Before an eruption, the water fills both the tube and basin, detonations are heard at intervals, and after the detonation a violent ebullition in the basin is observed; the column of water in the pipe appears to be lifted up, thus forming an eminence in the centre of the basin and causing the water to flow over its rim. The detonations are evidently due to the production of steam in the subterranean depths, which rising into the cooler water of the tube, becomes suddenly condensed and produces explosions. Between the interval of two eruptions, the temperature of the water in the tube gradually increases, but even immediately before an eruption, at no part of the tube is the water at its boiling temperature. How then is an eruption possible? Bunsen succeeded in determining the temperature of the water a few minutes before a great eruption; and his observations furnish the key of the entire enigma. A little below the centre he found the water within two degrees of its boiling point, that is, within two degrees of the point at which water boils under the pressure of the atmosphere, *plus the pressure of the superincumbent column of water.* The actual temperature at thirty feet above the bottom of the Geyser was 122° Centigrade, its boiling point being 124°. We have just alluded to the detonations and the lifting of the Geyser column by the entrance of steam from beneath. These detonations and the accompanying elevation of the column are, as before stated, heard and observed at various intervals before an eruption. Imagine, then, the section of water at thirty feet above the bottom to be raised six feet by the entrance of a mass of vapour below. The liquid spreads out in the basin, overflows its rim, and thus the elevated section has six feet less of water pressure upon it; its boiling-point under this diminished pressure is 121°; hence in its new position its actual temperature (122°) is a degree above the boiling-point. This excess is at once applied to the generation of steam; the column is lifted higher, and its pressure further lessened; more steam is developed underneath; and thus, after a few convulsive efforts, the upper part of the column of water, through the sudden boiling up from the middle downwards, is ejected with immense velocity, and we have the Geyser eruption in all its grandeur. By its contact with the atmosphere the water is cooled, falls back into the basin, sinks into the tube through which it gradually rises again, and finally fills the basin. The detonations are heard at intervals, and ebullitions observed; but not until the temperature of the water in the tube has once more *nearly* attained its boiling point is the lifting of the column able to produce an eruption.

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* Reported verbatim, by permission of the Author, for this journal.

"In the regularly formed tube the water nowhere quite attains the boiling-point. In the canals which feed the tube, the steam which causes the detonation and lifting of the column must therefore be formed. These canals are in fact nothing more than the irregular continuation of the tube itself. The tube is therefore the sole and sufficient cause of the eruptions. Its sufficiency was experimentally shown during the lecture. A tube of galvanised iron six feet long was surrounded by a basin; a fire was placed underneath and one near its centre to imitate the lateral heating of the Geyser tube. At intervals of five or six minutes throughout the lecture eruptions took place; the water was discharged into the atmosphere, fell back into the basin, filled the tube, became heated again, and was discharged as before.

"Sir Geo. Mackenzie, it is well known, was the first to introduce the idea of a subterranean cavern to account for the phenomena of the Geyser. His hypothesis met with general acceptance, and was even adopted undoubtingly by some of those who accompanied Bunsen to Iceland. It is unnecessary to introduce the solid objections which might be urged against this hypothesis, for the tube being proved sufficient, the hypothetical cavern disappears with the necessity which gave it birth.

"A moment's reflection will suggest to us that there must be a limit to the operations of the Geyser. When the tube has reached such an altitudo that the water in the depths below, owing to the increased pressure, cannot attain its boiling-point, the eruptions of necessity cease. The spring, however, continues to deposit its silica, and forms a *lang* or cistern. Some of these in Iceland are of a depth of thirty or forty feet. Their beauty is indescribable: over the surface a light vapour curls, in the depths the water is of the purest azure, and tints with its own hue the fantastic incrustations on the cistern walls; while at the bottom is observed the mouth of the once mighty Geyser. There are in Iceland traces of vast, but now extinct, Geyser operations. Mounds are observed whose shafts are filled with rubbish, the water having forced a way underneath and retired to other scenes of action. We have in fact the Geyser in its youth, manhood, old age, and death, here presented to us:—in its youth, as a simple thermal spring; in its manhood, as the eruptive spring; in its old age, as the tranquil *laug*; while its death is recorded by the ruined shaft and mound which testify the fact of its once active existence.

"Next to the Great Geyser the Strokkur is the most famous eruptive spring of Iceland. The depth of its tube is forty-four feet. It is not, however, cylindrical like that of the Geyser, but funnel-shaped. At the mouth it is eight feet in diameter, but it diminishes gradually, until near the centre the diameter is only ten inches. By casting stones and peat into the tube and thus stopping it, eruptions can be forced which in point of height often exceed those of the Great Geyser. Its action was illustrated experimentally in the lecture, by stopping the galvanised iron tube before alluded to loosely with a cork. After some time the cork was forced up, and the pent-up heat converting itself suddenly into steam, the water was ejected to a considerable height; thus demonstrating that in this case the tube alone is the sufficient cause of the phenomenon."

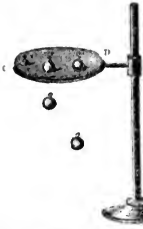
Throughout the lectures that have been hitherto given I have had occasion to admire the attention and patience of my younger hearers. My hearers are of different ages, but although I have been obliged to mention certain things that could not possibly be understood by the very young boys, and to mention some elementary facts which were, perhaps, very well understood by the older boys, yet the young boys have been patient when I spoke to the elder ones, and the elder ones have been patient when I spoke to the younger boys; and for this I feel very thankful. With reference to the present lecture I have to address all the boys, especially the elder ones, for I have to explain a term or two very much used at the present time in connection with the subject of heat.

If you carry a pound of any substance whatever to a height of 772 feet above the earth's surface, and allow it to drop down upon the earth from that height, you always get the same amount of heat generated, and that amount of heat would be just sufficient—I mean neither more nor less than sufficient—to raise the temperature of one pound of water one degree Fahrenheit. Thus, if you conceive a pound weight falling from this great height, 772 feet, and conceive all the heat generated by its collision with the earth collected together and put into a pound of water, that pound of water would have its temperature elevated one degree. Now, by proper means we can reverse this process, and by means of heat we can lift the pound weight. If we lift the pound weight to a height of 772 feet, of course we should then be pulling it, as it were, away from the earth which attracts it; and in order to lift this pound weight to that height we should consume—in fact, annihilate, destroy—an amount of heat equal to that which would raise a pound of water one degree in temperature; so that the amount of heat consumed in lifting the weight 772 feet is exactly equal to what is generated when the weight falls from a height of 772 feet. Now, if we lift one pound of matter one foot from the ground, a certain term is employed. It is called "*the foot-pound*;" and if you lift a pound weight to 772 feet it is 772 foot-pounds; or if you lift 772 pounds to the height of a foot you have 772 foot-pounds. Now, this quantity of 772 foot-pounds, which would raise the temperature of a pound of water one degree, is termed "*the mechanical equivalent of heat.*"

In lifting a weight from the earth we are overcoming attraction of the earth, and in doing this we consume heat, if heat be the agent which lifts the weight. Now, I have asked you over and over again to figure the atoms of solid bodies such as this I hold in my hand. As a general rule, when heat is communicated to a body the atoms are forced asunder. You know the enormous power and force with which these atoms may attract each other, for I showed you that when an iron bar was cooled the contractible force pulling together its atoms—the mutual attraction of its atoms on cooling—was sufficient to smash the steel bar which you saw broken in front of the table. Now, we have amongst the atoms of bodies pulling each other together an action substantially the same as that which occurs when we separate the weight from the earth. To this action we may give a name. Let us call this work which occurs in a body "atomic work" if you like—work done on the atoms. This work necessitates a consumption of heat. Heat is consumed in this way; and what I want you now to bear in mind is that the amount of heat consumed is very different indeed in different bodies; and consequently some bodies, in order to raise them one degree in temperature, require more heat than others. In order to raise one pound of the liquid metal mercury one degree in temperature a certain amount of heat must be imparted to it. It would require *thirty times* that amount of heat to raise a pound of water one degree in temperature. Water requires thirty times the quantity of heat required by mercury, simply because the work to be done is a great deal more than that necessitated in the case of mercury. Now, I want to show you what follows from this action. It would appear, in consequence of this atomic work which I have been speaking of, as if the water had a power of storing up heat thirty times greater than the power possessed by mercury; and, indeed, formerly people thought that heat *was* something stored up, and they called the amount of heat which it was needful to impart to a body to raise its temperature one degree its "capacity for heat." They looked at a body as a kind of vessel for heat, and hence they used this term "capacity for heat." It was found by experiment that the capacity for heat (as the term went) was very different in different bodies; and the amount of heat which a body had stored up was determined by what the body could do—by the amount of ice or wax which it could melt.

I have here a vessel of hot oil, and in it I have spheres of metal of different kinds. They are all equally hot at the present time; but you will find that these spheres of metal have very different powers in melting bodies. They will be placed on a flat piece of wax, D (Fig. 1), and their heat will act upon that piece of wax. Some will force their way through, and others will not. This ball of copper will go through the wax first. The tin will go partly through. The bismuth certainly will not go through, although it is just as hot as the copper. Here, too, we have a ball of lead which is not competent to melt its way through the wax. The ball of iron will go through. Here is a ball of zinc; I think that will go through; but I am sure that the lead and tin and bismuth will not do so. The balls of copper, iron, and zinc melted their passage through the slab of wax, and fell to the ground one after the other. The three other balls did not perforate the wax. This illustrates the different amounts of heat possessed by these bodies, although they are all at the same temperature.

Fig. 1.



We must now go on considering the heat consumed; and I must rapidly make a few experiments illustrative of the consumption of heat in this work of forcing the particles of bodies asunder or changing their position. One of the most remarkable cases of the consumption of heat occurs when a body is caused to pass from the solid state to the liquid. Here, A B (Fig. 2), I have a beautiful instrument [the thermo-electric pile], which has been introduced to your attention before. It is a kind of thermometer, and I want to show you how we can make use of this instrument for the purpose of ascertaining whether we have cold or heat. I cannot go into the full explanation of the thing; but if you observe the needle *m n* of the galvanometer G, to which it is connected by the wires *w w*, you will see how wonderfully delicate the instrument is. It is more delicate than any thermometer whatever. I will turn the face of that instrument towards me, or I will breathe against it, or I might allow any young philosopher present to breathe against it. The warmth of his breath would at once make itself evident by causing that magnetic needle to move. Now, as I breathe against this pile, you observe that the red end of the needle comes towards me. When the needle returns to its former position and comes to rest, I will try the effect of cold upon the instrument, which, you will remember, is called a thermo-electric pile. (You see I can stop the needle by means of this other needle in a moment.) I will now put a piece of this ice in a spoon, and on the cold spoon coming in contact with the face of the pile you will see that the red end of the needle will move towards you, and away from me. Thus, in this instrument we have the means of telling whether heat or cold has been imparted. We now again bring the needle to rest. And now we have made the acquaintance of this beautiful instrument, I will proceed to experiment with it. Here is a little flat basin, B, which I place upon the face of the pile, thus; and you observe that although that dish has been up to the present time resting upon the table it has become a little warm, and causes the red end of the needle to move

Fig. 2.

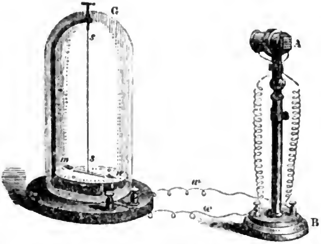
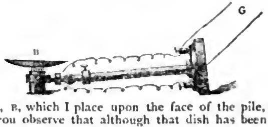
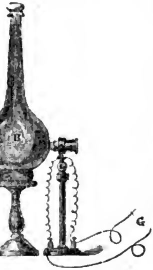


Fig. 3.



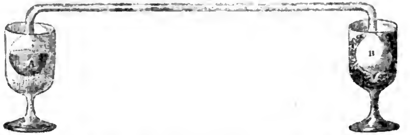
towards me. But when I pour a little cold water into this dish you see the suddenness of the movement of the red end of the needle towards you. I will now warm this water by dipping my finger into it, and after a time you will see that the needle will come down in consequence of the warmth imparted to it by my hand, and come back on the other side of the middle line. [After a pause.] You see that the needle now comes to my side, showing that the water is warmed by my finger. And now I might take sugar, or salt, or saltpetre, which would be still better, and put a little of the powder of that saltpetre into the water. That powder would become liquefied, and on its melting the warmth of the water is consumed—is used up, and the water is thereby chilled. Now, in making this experiment I will confine myself to a particular substance called sulphate of soda. You see that there is now a very great deal of heat imparted to the water by my finger, and that the needle comes very much on my side of the middle line. I will now pour into the water some powdered sulphate of soda, and you find that the water immediately becomes chilled by melting that sulphate of soda. This, then, is a consumption of heat by the act of liquefying or melting the sulphate of soda. I want now to make another experiment. It is a very instructive one. I want to show you the reverse of the last experiment. When dissolved sulphate of soda is permitted to solidify—become solid—you get out of it the heat that was expended in rendering it liquid. I have in this flask, B (Fig. 4), some dissolved sulphate of soda. It was carefully melted last night, and has been carefully kept apart from any thing which could disturb it. We will allow the face of the pile to rest against the bottle; and now I want to cause that body to solidify before your eyes. I can cause it to become crystallised sulphate of soda, like that which was dissolved in that dish a moment ago. You will see the liquid in the flask become more and more opaque, and when it begins to solidify opposite the face of the pile it will give out heat — the heat that was expended in melting it, and you will then see the red end of the needle come towards me. I will now open the neck of the flask, and throw a crystal of sulphate of soda into the solution. [This was done, and the contents of the flask began to solidify from the top downwards.] You now see the compound crystallising; and the moment that portion opposite the face of the pile becomes solid, heat will be communicated to the face of the pile, and we shall get a deflection (as it is called) of the red end of the needle in the direction in which I stand. [After a pause]—What I predicted was quite right. There we get out of the sulphate of soda the heat that was expended in melting it. There is the movement of the needle caused by the heat.

Fig. 4.



I might go on in this way, and show you that when a body is evaporated you also get a very large amount of heat consumed—used up—in order to evaporate it. In order to convert a pound of water at 212° Fahrenheit into steam at 212° Fahrenheit, an enormous amount of heat is required. It requires as much heat as would raise 967 pounds of water 1° Fahrenheit; and this heat is insensible to the thermometer, although it is so great. The reason that I employed a mixture of ice and salt as a freezing mixture in a former experiment, was that the action of the salt produces a liquefaction of the ice, and on that liquefaction taking place a large quantity of heat is consumed—so much that the temperature of the liquid is reduced far below the temperature of the ice itself. I am going to illustrate this point by the development of cold by vapourisation; and if things go fairly I should not wonder if I could freeze water before your eyes by means of its own evaporation. An experiment has been arranged there for the purpose. Here are two bulbs, A and B, in this apparatus (Fig. 5), and the water which was in one of them has been frozen in this room since the lecture began. One end of this has been placed in a freezing mixture far away from the bulb where the water is frozen. This instrument is called a "cryophorus," or ice carrier. Water was placed in one bulb, and the air was taken from the interior of the instrument. The other bulb was placed in a freezing mixture, and as the vapour came over from the water it was condensed by the freezing mixture, and the vapourisation which took place has been sufficient to freeze the water.

Fig. 5.



So much, then, for the heat consumed in causing a body to pass from the liquid state to the state of vapour. I have on the table various substances which would enable me to illustrate this in a very satisfactory manner. For instance I will take a little alcohol, and warm it by placing my finger into it, thus. I see there is a great amount of heat in the face of the pile. I have no doubt that the evaporation of the alcohol will very soon cause the end of the needle to come down; or if I take a substance that can vapourise more rapidly than alcohol—this substance, ether—it would not take an instant in order to overcome the heat which is the cause of that deflection. I will cause evaporation to go on a little more quickly, and if the needle be not held fast by some accident we shall soon find the heat which causes the present large amount of deflection entirely abolished, and the needle will move down. Now you see the needle comes back. We get an enormous amount of cold by the evaporation of ether, so much that we can easily freeze water by it.

(To be continued.)

Isoxylol, Preliminary notice.—R. Fittig. Mesitylenic acid, the product of the reaction of diluted nitric acid upon mesitylene, is decomposed by being heated with caustic lime according to the equation—

$$C_9H_{10}O_2 = C_8H_{10} + CO_2.$$

The new hydro-carbon isoxylol resembles its isomer xylol very closely in many points, but widely differs from it in its behaviour towards oxidising agents. Chromic acid, for instance, converts xylol into terephtalic acid, while isoxylol is oxidised to isophtalic acid, isomeric with the former. This new acid is readily soluble in alcohol, almost insoluble in cold, sparingly soluble in hot water. From the latter it crystallises in long needles, which fuse above 300°C. A dibasic homologue of isophtalic of the composition $C_9H_8O_4$ has been obtained by slow oxidation of mesitylenic acid, besides tribasic trimesinic acid, described on a former occasion.—(*Zeitschr. Chem.*, N.F. iii., 526.)

ON THE INFLUENCE OF

APERTURE IN DIMINISHING THE INTENSITY OF THE COLOUR OF STARS.*

By JOHN BROWNING, Esq., F.R.A.S.

AT the last meeting of the Society some remarks were made on the subject of the amount of colour visible on the moon during the late lunar eclipse.

I had previously stated that I had failed to detect either the coppery or the blue tints generally seen during the occurrence of this phenomenon. As my observation did not agree with those of several well-known observers, I have given the matter some attention, and endeavoured to ascertain from what cause the discrepancy proceeded.

Mr. Slack suggested that probably my having used a telescope of larger diameter than those employed by most of the observers would prove the explanation desired, and since then I have heard that our able Secretary, Mr. Huggins, is of the same opinion. The result of my inquiries completely confirms this suggestion. I find that while most observers who use telescopes of only three or four inches aperture speak of the colour as being less than usual, yet very noticeable, observers who use telescopes of seven or eight inches aperture saw very little colour. Neither Mr. Barnes nor myself, observing with a 10¼-aperture, nor Mr. With or his nephew, employing a 12¼-inch silvered-glass speculum, could detect any colour at all.

It is true that I failed equally in detecting colour with a 4-inch object-glass, but I account for this by supposing that the sensitiveness of my eye to faint-coloured light had been injured by the glare of the moon in the large aperture. Experimenting in connection with this subject, I have noticed that the chocolate colour of the so-called belts of *Jupiter* is much more perceptible with 6-inches apertures than with 12 inches. Again, a small star in the cluster in *Perseus* appears of an indigo-blue with 8½ inches, Prussian-blue with 10¼-inches, and royal-blue with 12¼ inches of aperture. It follows from this that colours estimated by comparison with the ingenious chromatic scale of Admiral Smyth, in which each colour is represented of four different degrees of intensity, will not possess any relative value unless taken in connection with the aperture employed when the colour was estimated. Were due allowance made for this disturbing influence of variation of aperture, I think many discrepancies between the colours attributed to double stars by different observers might probably be reconciled.

Note.—An enlarged diagram of Smyth's chromatic scale, and another showing the apparent difference in the colour of a star when seen with apertures of 4 inches and 12 inches, was exhibited and described at the time the paper was read.

OBSERVATIONS ON THE

NATIVE HYDRATES OF IRON.

By GEORGE J. BRUSH.

WITH ANALYSIS OF TURGITE.

By CHARLES S. RODMAN.

THE well known iron mines of Salisbury, Conn., have long enjoyed a reputation among mineralogists as furnishing superior specimens of *limonite*, and hitherto this has been thought to be the only ferric hydrate occurring in quantity at this locality. Minute crystals of supposed Göthite have occasionally been found, but not in quantity sufficient to render certain their mineralogical determination.

On a recent visit to these mines Mr. Rodman obtained a considerable number of specimens, lining pockets in the ore, which had the usual brilliant metallic lustre on the interior surface, and showed on the fracture a fibrous structure, but differed from brown hæmatite in having a decidedly red colour, and in affording when pulverised a red powder, closely resembling that of ordinary red hæmatite. This red layer was in some cases an inch or more in thickness, and was deposited on a bed of limonite (brown hæmatite); the line of demarcation between the brown and the red ore was so perfect, in most instances, as to readily admit of a complete separation of the two minerals.

An examination of this red ore showed it to be an oxide of iron, containing not far from 5 per cent of water, a number of specimens yielding very uniform results; and a complete analysis proved the mineral to be a ferric hydrate with the formula $Fe_2O_3 2HO$, identical with the *Turgite* of Hermann,† and with Breithaupt's *hydro-hæmatite*, as analysed by Fritzsche.‡ The physical characters are so nearly those of ordinary anhydrous hæmatite that it is difficult to distinguish the species without having recourse to an estimation of the loss on ignition. The turgite yields an abundance of water when heated in the closed tube, and it decrepitates in a remarkable manner. Hardness, about 5·5. G.=4·14. For analysis the mineral was carefully dried over sulphuric acid until of constant weight, and this desiccated mineral was then heated for several hours in an air bath at 100° C. without showing any further diminution of weight. The amount of hygroscopic moisture abstracted from the air-dried mineral by treatment in the desiccator was 1·40 per cent. The iron in one instance was determined by titration with permanganate of potash; in the second case it was thrown down by ammonia, the precipitate washed, dried and weighed, and then the iron was separated from the silica and alumina by Deville's method by first reducing with hydrogen, and subsequently volatilising the iron by heating in a current of dry hydrochloric acid gas. The analytical results were all obtained by Mr. Rodman. Composition:

	1.	2.	Mean.
Ferric oxide	91·45	91·29	91·36
Manganic oxide	0·67	0·55	·61
Alumina	0·75	.....	·75
Silica	0·22	0·24	·23
Phosphoric acid, sulphuric acid, and cobaltic oxide	traces	.....	traces
Insoluble in acid	1·83	.....	1·83
Water	5·20	5·21	5·20
	100·12		99·98

Other determinations of water on different specimens gave 5·02 and 5·09 per cent.

Five grammes of the mineral yielded only minute traces of sulphuric acid, and three grammes showed but an unweighable trace of phosphoric acid. A very perceptible trace of cobalt was found even on examination of one gramme of the mineral. The portion insoluble in acid proved on analysis to consist entirely of silica, and excluding this, with the small amount of silica and alumina found in the soluble portion, the result of the analysis is

$$\begin{array}{llll} & \mathrm{Fe_2O_3}\ 94{\cdot}00 & \mathrm{Mn_2O_3}\ 0{\cdot}63 & \mathrm{HO}\ 5{\cdot}35 = 99{\cdot}98 \\ \text{Oxygen,} & \multicolumn{2}{c}{\underbrace{28{\cdot}20 \qquad\qquad\qquad 0{\cdot}19}_{28{\cdot}39}} & 4{\cdot}75 \end{array}$$

giving the oxygen ratio 6 : 1 or $Fe_2O_3 2HO$.

This result confirms the conclusions of Hermann and Breithaupt, that there is a native ferric-hydrate with one half an equivalent of water. Several years since the attention of the writer was called to this subject by Prof. W. T. Roepper, of Bethlehem, who stated that he had found Breithaupt's hydrohæmatite to be of frequent occurrence with the limonite ores of the Lehigh valley. A water determination on the Lehigh mineral made by Prof. Roepper, and kindly communicated for this article, gave 5·34 per cent, and Prof. Roepper calls especial attention to the characteristic decrepitation of this mineral when heated. On examination of the specimens of limonite in the Yale College collection, a fine specimen of the red hydrate was found occurring with the limonite of Düsseldorf in Prussia, this yielded on examination by Mr. Rodman 4·75 per cent water. Another specimen was found from Ioditz in Bavaria, besides numerous specimens from Salisbury in Connecticut. A mineral of like composition has also been found by Bergemann[*] at the Louisa Mine near Horhausen in Prussia. From these numerous localities it would appear that the mineral is of common occurrence. It has heretofore been confounded by most mineralogists with hæmatite, which it so strongly resembles in physical characters. It may be readily distinguished from hæmatite by simply heating a fragment in the closed tube, when it decrepitates violently and gives off large amount of water.

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* Proceedings of the Royal Astronomical Society.

† Journal für praktische Chemie, xxxiii, 97.

‡ Breithaupt, Vollständiges Handbuch der Mineralogie, iii, 840.

Hermann does not give the pyrognostic characters of *turgite*, but Breithaupt, in his description of *hydro-hematite*, makes particular mention of its characteristic decrepitation when heated. The turgite is described by Hermann as being associated with copper ores; its chemical composition is however identical with hydrohæmatite, and as it has priority of publication, the species must bear the name of turgite, and hydrohæmatite be used only as a synonym.

We have therefore three well defined hydrates of iron occurring native and forming three distinct and well-established mineral species, differing from each other in physical characters and in their relative content of water.

Turgite .. .. .. $Fe_2O_3 + \frac{1}{2}HO$
Göthite .. .. .. $Fe_2O_3 + HO$
Limonite .. .. $Fe_2O_3 + 1\frac{1}{2}HO$

Two other hydrates have been described containing respectively two and three atoms of water. Murray[*] found in a brown iron ore from Huttenrode in the Hartz—

Fe_2O_3 81·41, HO 17·96, SiO_3, 0·17, Carbon 0·46 = 100, giving the formula $Fe_2O_3 + 2HO$.

A compound of similar composition from Kilbride in Ireland, having a pitchy colour, analysed by Haughton, gave Fe_2O_3 77·15, HO 20·43, SiO_3 0·30, Al_2O_3 tr., PO_5 1·60 = 99·48.

Xanthosiderite also appears to be a mineral of like composition, but its mixture with a silicate of unknown composition renders it difficult to conclude positively that it belongs here.

A. H. Church[†] has analysed a stalactite of a rust-coloured ferric hydrate from Botallack mine in Cornwall, which gave:—

Fe_2O_3 73·70, HO 24·40, loss, PO_5, and organic matter 1·76 = 100, giving the formula $Fe_2O_3 + 3HO = Fe_2O_3$ 74·77, HO 25·33.

Other analyses of ferric hydrates by many different analysts, and from a great range of localities, give an amount of water which corresponds to one or the other of these last two hydrates; but as these contain also either organic matter, phosphoric acid, or silica in the combined state, it is impossible, without further investigation, to know to what hydrate to refer them.

The artificial ferric hydrate precipitated by ammonia from ferric chloride varies in composition according to the method of treatment. Schaffner obtained a hydrate with one atom, Gmelin with two atoms, and Wittstein with three atoms of water; this last kept for some time under water became crystalline, and was converted into a hydrate with one and a half atoms of water. Recent investigations by E. Davies[‡] show that the ordinary precipitated ferric hydrate loses water on being boiled in water; in one case the amount of water was reduced to 3·52 per cent. Similar experiments conducted in this laboratory by Mr. Rodman showed that by continued boiling in water the amount of water remaining in the hydrate could be reduced even to two per cent. These facts, as Mr. Davies suggests, explain in a very satisfactory manner the association of the different ferric hydrates in nature, and do not necessarily demand the supposition of great heat to account for the large beds of anhydrous hæmatite found in different parts of the world.

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[*] Rammelsberg, Handbuch für Mineralchemie, 988.
[†] Journ. Chem. Society, II. iii. 214.
[‡] Journ. Chem. Society, II. iv. 69.

FOREIGN SCIENCE.

PARIS, JAN. 28, 1868.

Science in the prisons.—The gallic fermentation.—Spectra of flames issuing from furnaces.—Action of the Alkaline Silicates on the Animal Economy. ACADEMY OF SCIENCES, January 6.—On the molecular theory of bodies.—Employment of the electric light.—Estimation of small quantities of peroxide of hydrogen.—Action of chloride of cyanogen on zinc ethyl.—Sitting of Jan. 13th.—Electro-capillary actions.—Blue colouring matter of certain dead woods. Sitting of Jan. 20th.—Titles of papers.

As showing an advantage, unrecognised, perhaps, by many, of living under enlightened rulers in a country where chemical science is appreciated, the mention of a strange fact related in one of the scientific journals may find place here. The narrator visiting a prison asked his guide, are the prisoners well nourished? "Mon Dieu, Monsieur," the man replied, "the bill of fare for each day has been prepared by a special commission, 33 per cent nitrogenous matter, 27 albuminoid, 15 of gelatin, 18 of fibrin, 7 of hydrated matter." The guide also informed him that each prisoner had, besides, the right to 10 cubic metres of respirable air, 10,000 litres!

Some account of M. Van Tieghem's memoir on the gallic fermentation, presented to the Academy of Sciences, has been promised for these columns. M. Van Tieghem has treated the subject elaborately. At the outset he alludes to the diverse opinions which have been expressed with regard to the causes, besides the oxygen of the atmosphere, which lead to the transformation of tannin into gallic acid. One opinion attributes this result to a slow oxidation, and to the pre-existence of a soluble ferment; and some have admitted, while others have denied, the presence of sugar in the products.

1. Tannin does not undergo the metamorphosis when protected from the atmosphere. If a series of flasks be filled entirely with a solution of tannin or a filtered infusion of nut-galls, and placed in vacuo for 24 hours, then saturated with carbonic acid, carefully corked and heated, and finally sealed while hot, the solution will remain unchanged for any length of time. The transformation of tannin into gallic acid is not, then, due to the pre-existence of a soluble ferment.

2. Tannin does not undergo metamorphosis by simple contact with the air.

A solution of tannin introduced into a series of flasks drawn out at the neck and curved, boiled for some minutes, and left in a quiet place at a temperature of about 25° C., will remain unchanged for any length of time.

3. For tannin to undergo the metamorphosis, the development of a species of fungus in the solution is essential and sufficient. The gases composing the atmosphere alone effect no change, but the atmosphere carries to the solution spores, and these require for their germination oxygen. Under these influences the tannin splits up into gallic acid and glucose, the elements of water becoming fixed. When the transformation is complete, the whole of the gallic acid indicated by theory is found, but the glucose is always in less and somewhat variable proportion; the vegetation assimilates a part of it. Thus the sugar from the tannin furnishes the hydrocarbon aliments necessary to vegetable life. For the reaction described to take place, the plant must be developed in the interior of the solution; if only developed on the surface, the amount of vegetation germinated is immensely greater, but the reaction then takes quite a different form. Large quantities of carbonic acid are exhaled, and from a concentrated solution only a small quantity of gallic acid and traces of sugar remain after a few days' exposure. It remains to be shown that the fungus, during development and life, splits up the tannin, and that the change is not the result of soluble principles secreted by the latter, capable of acting without the organism. To establish this it is only necessary to introduce into a solution of tannin some of the vegetation from an active fermentation, and excl

the air as in the first experiment. The fungus developed is that known as the *Penicillium glaucum* or the *Aspergillus niger*.

The Austrian Professor, M. Lielegg, has made some observations with the flames coming from furnaces in which iron is worked solely by the Bessemer process. This flame is carbonic oxide in a state of incandescence. The appearance and disappearance of spectral lines mark the progress of the metallurgical operations. At the moment when the decarburisation of the iron commences, and when it has reached the proper limit, these lines suffer essential modifications. The appearance of a group of lines and of one distinct line at the violet end, marks an important stage during the formation of malleable iron; these lines disappear sooner than any of the others, this effect taking place within the last five minutes of the operation, so that they serve to denote the termination.

The action of the alkaline silicates on the animal economy has been studied by M. Husson. His experiments were made upon dogs. Solutions of silicate of sodium were administered to them; they were afterwards killed, and the organs submitted to chemical examination. These are some of the results M. Husson has arrived at. The alkaline silicates given in quantity so minute, that the contents of the stomach remain acid, are completely decomposed, the same is the case when they are in very dilute solution: the intestinal juices are unable to redissolve the silica. It follows that the alkaline silicates can only enter into the blood when administered in sufficient quantity to be alkaline in the small intestine. Traces only are found in the blood. No deposit forms in the brain, the liver, the bile, or the bones; but the muscles contain appreciable quantities of precipitated silica, as does the spleen. By far, however, the largest quantity of silica is precipitated in the urine as silicic acid and silicate of lime. M. Husson explains the precipitation in the muscles as being due to the acid developed during exertion, biphosphate of sodium playing the same part in causing the urinary deposit. The symptoms produced are—turbidity in the urine, difficulty in passing the same, and congestion of the kidneys.

At the *séance* of the Academy of Sciences held on Jan. 6, M. Guldeberg sent a very mathematical paper on the molecular theory of bodies. M. Becquerel presented a note by M. Le Roux on experiments relating to the employment of the electric light. M. Houzeau made known a method of estimating small quantities of peroxide of hydrogen.

In the presence of an acid peroxide of hydrogen decomposes either in the cold, or when heated, a solution of neutral iodide of potassium; iodine is set at liberty, and potash formed, which combines with the acid according to the equation—

$$HO_2 + KI + \text{acid} = HO + KO, \text{acid} + I.$$

As a consequence of this it is evident that by simply estimating the potash formed, the amount of peroxide of hydrogen is arrived at. The process is conducted as follows. Titrated acid is first added to the neutral oxygenated solution, and then a slight excess, usually a few drops, of neutral iodide of potassium. The mixture is heated to aid the reaction, and the iodine completely expelled by ebullition. Finally a titration is performed with an alkaline solution. Thus the amount of residual acid is estimated. The solution of iodide of potassium is made by dissolving three grammes of the salt in 100 grammes of water. When the sulphuric acid and neutral iodide of potassium are sufficiently diluted, they do not react upon each other, either in the cold or upon heating. Contrary to what has been observed with regard to ozone, oxygenated water does not seem to react with iodide of potassium when the solutions are neutral. But the vapour of peroxide of hydrogen blues, notwithstanding at the ne time that ozone does the iodide and starch-paper. al iodide of potassium can equally serve to detect ed water when this has been previously acidu- most cases the yellow or pinkish colour given to the solution may be considered characteristic of peroxide of hydrogen; but the sensitiveness of the reaction is augmented by the employment of chloroform, which is rendered violet or rose-coloured by traces of iodine invisible in water. Nitrites, hypochlorites, and other analogous salts react on iodide of potassium in the same manner as oxygenated water. This source of error may be removed by operating as follows:—3 or 4 c.c. of liquor is rendered acid, if neutral or alkaline, by a sufficient quantity of very dilute sulphuric acid. The addition of a few drops of iodide of potassium is the next step. A yellow or red colouration produced indicates the presence of oxygenated water, or nitrites and analogous salts. The experiment is then repeated after previously boiling the acidulated solution for a few minutes to expel nitrous acid, &c. If upon the addition of the iodide it still produces a colouration, this indicates the presence of peroxide of hydrogen. If in the cold there is no colouration, the solution is heated; if the reaction takes place, oxygenated water is present. If no colouration is produced under this treatment, a drop of chloroform is added, and the mixture agitated for a few minutes at about 40° C.; a rose tint indicates the presence of oxygenated water; if no tint is produced, it may be concluded that the solution does not contain oxygenated water, or that quantity is too minute to be detected. A solution may be concentrated either in vacuo or over quick-lime. Concentration may also be effected by heat. A very dilute solution of oxygenated water containing sulphuric acid may be boiled for some minutes without suffering an appreciable decomposition.

A paper entitled "researches on the action of chloride of cyanogen on zinc ethyl," by M. Gal, was presented by M. Fremy. M. Gal recounted the experiments he had made. He finds by acting upon zinc ethyl by gaseous chloride of cyanogen, a liquid is obtained, boiling at 98°, identical with hydrocyanic ether; the reaction is the following—

$$C_2NCl + C_4H_5Zn = C_4H_5C_2N + ZnCl.$$

The author undertook the research in order to throw light upon the constitution of hydrocyanic acid, and to determine which of the two isomeric ethers of this acid should be considered as its homologue: he has not been able to decide. One of the ethers boils at about 82°, the other at 98° C. On the 13th of January, M. Becquerel made known the results of further experiments upon electro-capillary actions; this is the fourth memoir upon the subject. In decomposing mixed metallic solutions, he has observed that the metals are deposited separately: from a solution containing nitrate of silver and nitrate of copper, the metallic silver is alone deposited. M. Thénard presented a paper, by M. Romier, on the blue colouring matter of certain dead woods. M. Romier thought of the matter being applicable to dyeing purposes, and specimens of silk owing their tints to it were examined by the Academy. At the meeting on the 20th of January, Father Secchi contributed a second note on stellar spectra. There was also a note on the colouration effects which are produced when the sparks from an induction coil pass between the surface of a liquid and a platinum pole, from M. Becquerel. M. Dupré presented a memoir on molecular attractions and chemical operations. M. Miergnes addressed a communication describing a new pile composed of zinc and carbon. Having already covered the space accorded to him in these columns, your correspondent must content himself at present with simply announcing these interesting papers.

Cymol from Camphor.—Longuinin and Lippmann. Equal molecules of camphor and phosphoric perchloride are intimately mixed, and the mixture very slowly distilled from a retort. The distillate is washed with water, dried, and rectified over sodium. It is then quite pure, having its boiling point between 175° and 178° C.—(*Bull. Soc. Chim.* vii. 374).

DR. LETHEBY ON FOOD.

Lecture II.

(FROM OUR OWN REPORTER.)

Dr. Letheby delivered this, his second lecture "on Food," at the rooms of the Society of Arts, John Street, Adelphi, on Monday evening, the 27th instant, in the presence of a numerous audience. Dr. Letheby commenced by stating that the relative properties and digestive functions of food were purely physical, and chemical in their character. There was, he remarked, a greater number of solvents in the alimentary canal than one would suppose. The saline and gastric juices acted with great force, and the quantity of those foods poured in for the purposes of digestion amounted to rather more than 3 gallons in the twenty-four hours. The amount of saline was 3¼ lbs., in which there was 231 grains of solid matter; 14$\frac{1}{10}$ lbs. was made up of the gastric juices containing 3,000 grains of solid matter, and 316 grains of pepsine; the pancreatic acid 8·82 lbs., in which was 6,000 grains of solid matter, and 784 of a peculiar principle of fat and starchy matter; bile 3¼ lbs.; and the intestinal mucus ¼ lb. Food in the alimentary canal is not only submitted to the action of solvents but also that of water, drenching the food rather than dissolving it. Saline matter is secreted by many of the glands, and is composed of foods all slightly alkaline at the time of digestion; though at this time the potato is strongly acid in the interval of passing from the stomach to the alimentary canal. The potato is composed of liquid and solid matter, half of which is inulin, which is something like the peculiar principle found round the germ of all seeds, and which is of such a character that it will not pass through the membranes of the body, but is discharged through the alimentary canal. There were some articles which served artificially to promote digestion, such as Liebig's extract of malt, which proved to be a powerful solvent. The gastric juice which is secreted from the glands is a thin transparent fluid, and from possessing a large proportion of organic matter called pepsine this fluid has the power of changing albumen, which is known as pepsine or albuminous peptone, and which differs from ordinary albumen in this respect that it is not coagulated by heat. This ordinary albumen will not, however, pass through the membranes till acted upon by pepsine. The digestive power of the gastric juice is destroyed if the temperature gets above 120° Fahrenheit or below 100° Fahrenheit. At the latter point the digestion does not take place very rapidly. Dr. Letheby then described how this gastric juice was obtained from the stomachs of pigs and sheep, stating that it was when the animal had been kept unfed for some time, and when his whole nervous system was excited by the smell of some savoury dish that it was killed, and that the quantity of the pepsine produced from the stomach of the pig was better than that obtained from the sheep. He then proceeded to say after a few words respecting pancreatic acid, observing that it was a clear colourless fluid possessing the power of being either alkaline or acid whose functions were were not well known. Twenty years ago Bernard had thought it possessed the power of making soap, but lately Mr. Schweitzer, of Brighton, had carefully gone into the subject, and found that it made fat. It possessed a powerful solutive action; and it may—though this is generally denied—act on nitrogenous matters. Dr. Letheby then proceeded to devote his attention to what he said was a very complex subject, and on which he should say but little—the bile. It was of a yellow colour, and slightly alkaline, which came into the body daily to the quantity of 3¼ lbs., of which about 14 per cent was solid matter, of which 12 are organic. Several hypotheses were presented to the meeting, and the lecturer, whilst not being able to pronounce positively upon the matter, seemed inclined to believe it to be a residuum from the liver in making blood to circulate through the body. After a few words bestowed upon the intestinal mucus, Dr. Letheby proceeded to apply the facts already gathered to an explanation of the phenomena of digestion, first taking protinaceous or nitrogenous matters digested by the gastric juices, of which there are several divisions, their order of easiness in digestion being as follows, viz.:—Liquid and soft albumen, then hard albumen, followed by fibrine, gelatine, cartilages, and appendages of the skin, in the order just named, showing, as regards the latter division, that all appendages, such as hair, feathers, and wool, were thoroughly insoluble; citing, as an example, the case of the boa at the Zoological Gardens, who some years ago, swallowed his blanket which, a few days afterwards, was cast out of the alimentary canal uninjured; that starch was converted into the low form of sugar known as glucose; that gums and all bodies of a similar character were indigestible, and were therefore not only worthless but did harm, causing other food to be hurried in its passage through the body, and that saline matters were digested by the acid of the stomach. Dr. Letheby then proceeded to state what were the most digestible kinds of food, quoting Dr. Bowman's observations made under highly advantageous circumstances. Dr. Bowman had a patient whose wound affected the stomach, and which required to be kept open. By these means Dr. Bowman was enabled to see the processes the food swallowed by the man underwent during the time of digestion; and also to learn the time required for the digestion of the food taken into the body. The result of his observations was that soused tripe was the most digestible of all foods, taking but one hour to digest; that venison ranked next, taking one hour and a half; then raw eggs or raw oysters, taking one hour and three-quarters; ox liver, two hours; poultry, lamb, and hard boiled eggs, two hours and a-half; beef and mutton two hours and three-quarters to three hours and a quarter; pork, three hours and a quarter; and lastly, salt beef, four hours.

The question, How digestion may be helped on? possesses the following answer. There must be a proper selection of foods as regards tenderness and flavour; a proper variation of the food from day to day, and by carefully watching how this food is cooked; and by the maintenance of a proper temperature of the body and of a cheerful temper.

The chief constituent of food is water, and the liquid makes its appearance in all parts of the body to the extent of 75 per cent. Thirty pounds per diem is wanted to properly carry on the process of digestion, and its importance may be fully appreciated when we see that it dissolves tissues, and carries the blood into circulation; that it carries out of the body waste; that it cools the body when unduly heated; and that it lubricates the whole system. Like everything else, however, it must be taken in a proper manner; least in the morning, more at noon, and most at night, when it is greatly required to carry off the accumulated wasted tissues, and leave the body clear for the next day's operation. Dr. Letheby then passed on to nitrogenous or plastic matter, and showed how gradually, from the belief that the nitrogen within us supplied our muscular force, it had come to be disputed, questioned, experimented upon; and that finally in the year 1866 two professors of Zurich, Fick and Wislecenus, had taken the trouble to put the matter to a practical test by ascending the Faulhorn, one of the Bernese Alps, and at an altitude of 6,417 feet above the level of the Lake of Brienz. During the day before, the time whilst they were at their work, and for a few hours after, they religiously abstained from eating any thing containing nitrogenous matter. The ascent of the mountain took six hours, and during that period, and for some time afterwards, they collected all the secreted nitrogenous matter, which by the most liberal computation but provided for half the strength requisite for these two gentlemen to reach the top of the mountain; and to prove that more nitrogen was evolved before and after the work was done, the quantity of nitrogen sensibly increased after a meat meal. Dr. Letheby then proceeded to give some interesting statistics to prove the muscular force these quantities of nitrogen represented; showing that calculation should be made for the beating of the heart, respiration, and so forth, all of which went to prove the fallacy of the assertion that the burning of nitrogenous matter gave us our muscular force. Nothing of the sort could occur till the hydrocarbons in the blood were burnt, and then the nitrogenous matter could ignite; but it would be even then the hydrocarbons which were creating the muscular power; and if a test was required to prove that it was the carbon that was thrown off by exertion, there was one at hand. Take a man: during sleep he will but exhale 293 grains of carbon in the hour; let him be lying down in a state approaching sleep, and the rate increases to 355; let him sit up, to 448; let him walk two miles an hour, 1,088; let him walk three miles an hour, 1,552; and if you let him work at the treadmill at the rate of 28·65 feet per minute, 2,926. What better proof can be afforded than this, for here we have, speaking in round numbers, when all is calm and at rest, the man but breathes 300 grains of carbon per hour, whilst when he is working hard at the treadmill, 3,000. The result of the calculations must be that the chief agent of heat and force is hydrocarbon, and that nitrogenous matter goes to replace muscle; that muscles do not decay or oxidise during working, but afterwards; and that nitrogenous matter comes from food, and not from worn-out muscle. They nitrogen must be present there can be little doubt; our habits necessitate out eating meat, and the best example of this fact is that a party of Hindoos who commenced to make a line of rail were obliged to dispense with the laws of their caste and live like English navigators to enable them to complete the work. Nor can there be any doubt that too rich nitrogenous food produces force, and that a nation of meat eaters are more pugnacious than one of vegetable or carbon eaters. A brief review was then taken of the functions of fat, starchy, and saccharine matters, saline substances, and those beverages we are accustomed to indulge in at meal times, the lecture being concluded with a consideration of the question, what amount of work an average man can do in a day? The answer, based upon a comparison of the previous calculations undertaken to show the work done by the two professors whilst ascending the mountain, being that the average work a man is capable of performing, provided he is properly fed, is 10,000 lbs. lifted 1 foot high. In the inquiry, however, we learn this, that a man's external force is but $\frac{1}{5}$th portion of the whole force he possesses, and that an ordinary 10-horse steam engine will do the same amount of work at a cost of 5d. per hour, whereas the expense incurred by using a man would be £2 sterling.

On some Sources of Coal in the Eastern Hemisphere.—By Cuthbert Collingwood, M.B., F.L.S. 1. *Kelung, Formosa.*—The coal is found in depressions in red sandstone, and is of comparatively recent origin. It is light, burns very rapidly, gives out great heat, produces 50 per cent of ash, and forms considerable quantities of clinker. 2. *Labuan, Borneo.*—Several seams of coal crop out conspicuously near the coast, the lowest being 11 feet 4 inches in thickness. It is heavy, close-grained, fast-burning, and gives out considerable heat; it is of very recent date, dammara resin, and leaves of recent trees being found associated with it. 3. *Diu, Saghalien.*—Coal excellent, burns quickly, with little ash. Presents a fracture similar to Welsh coal. 4. *Japan.*—The author describes coal from several localities in Japan as bright, clean, and resembling Sydney coal, but having a tendency to form clinker. He concludes with a description of some coal from Ivanai, Niphon, which is very blean, highly bituminous, burns with a flame in the flame of a candle, and would probably be valuable as a gas producing material.—*Abstract of a paper read before the Geological Society.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Conversion of Gallic Acid into Tannin—T. Löwe finds that gallic acid in aqueous solution is converted into tannic acid by the oxidising influence of argentic nitrate. The oxidation is more complete if a salt of gallic acid is employed.—(*Journ. pr. Chem.* cii. 111).

Acetylene.—R. Rieth. The imperfect combustion of coal gas which takes place when the flame of a Bunsen's burner has gone down, so as to burn within the tube, has been found to be a rich source of acetylene. The escaping gases are collected by means of a funnel placed over the burner, and connected with an aspirator. The quantity of the silver compound of acetylene obtained from one burner in twelve hours amounted to 100 grammes.—(*Zeitschr. f. Chem.* N.F. iii., 598).

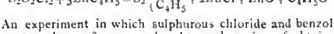
Oxidation of Potassium and Sodium.—The oxidation of potassium and sodium, when exposed with a clean surface to the air, is accompanied, according to H. Baumhauer, with evolution of light.—(*Journ. pr. Chem.* cii. 123).

Viridinic Acid.—O. Cech. This acid may be obtained direct from coffee by pulverising the beans, extracting them with ether alcohol, to remove fat, and exposing them in moist condition to the air. After a few days the mass, which has assumed a green colour, is exhausted with acetic acid and alcohol, which takes up the viridinic acid formed.—(*Ann. Chem. Pharm.* cxliii. 366.)

Preparation of Iodhydric Acid.—C. Winkler. Instead of preparing this acid by passing a current of sulphuretted hydrogen through water, containing iodine in suspension, the author proposes the following plan of working. Iodine is dissolved in carbonic disulphide, water placed on the top of this, and the sulphuretted hydrogen passed to the bottom of the vessel into the iodine solution. The dark colour of the latter gradually becomes lighter, while the iodhydric acid formed is completely absorbed by the water. The sulphur which separates remains dissolved in the carbonic disulphide.—(*Journ. pr. Chem.* cii. 33.)

Derivatives of Xylol and Dimethylbenzol.—R. Fittig. A careful comparison of methyltoluol, or dimethylbenzol $C_6H_5(CH_3)_2$ (obtained by replacing in toluol one atom of hydrogen by one of methyl) with xylol from coal tar, has shown that these hydrocarbons are not identical. Both, however, are converted by oxidation with diluted nitric or chromic acid into the same derivatives, *i.e.*, toluylic and terephtalic acid. Amongst the compounds prepared and examined were nitroamidoxylol, nitroamidomethyltoluol, diamidoxylol, dibromxylol, dibrommethyltoluol, parabromtoluylic acid, nitroparabromtoluylic acid, paradibromtoluylic acid, monobromnitroxylol, dixylyle.—(*Zeitschr. Chem.*, N.F. iii., 523.)

Derivatives of Sulphurous Chloride.—Fr. Grauhe. Sulphurous chloride is prepared by passing a current of sulphurous acid into phosphoric perchloride, and subjecting the products of the reaction to fractional distillation. The pure chloride boils between 78° and 79° C. Argentic cyanide converts it into sulphurous cyanide $S_2O_2(C_2N)_2$, which is insoluble in water, soluble in alcohol and ether. From the latter it crystallises in long needles. Zinzic ethide decomposes sulphurous chloride with formation of ethylic sulphide according to the equation—



$$S_2O_2Cl_2+3ZnC_4H_5=S_2\left\{\begin{matrix}C_4H_5\\C_4H_5\end{matrix}\right.+2ZnCl+ZnO+C_4H_5O$$

An experiment in which sulphurous chloride and benzol were made to act upon each other with a view of obtaining phenylsulphurous acid, was unsuccessful.—(*Ann. Chem. Pharm.* cxliii. 263.

Double-chlorides of Platinum.—K. Birnbaum. Plumbic chloride dissolves readily in a concentrated neutral solution of platinic chloride. On evaporation crystals of plumbo-platinic chloride $Pb\ Pt\ Cl_6 + 4H_2O$ separate. An ammoniacal solution of argentic chloride added to ammoniacal platinic chloride, causes the formation of a yellow crystalline precipitate, which after desiccation over sulphuric acid had the composition—

$$2NH_3 + 2AgCl + PtCl_4 + H_2O.$$

No definite compound could be obtained with mercuric chloride.—(*Zeitschr. f. Chem.* N.F. iii. 520).

CORRESPONDENCE.

WATER ANALYSIS.

To the Editor of the Chemical News.

SIR,—As is mentioned in your report of the proceedings at the last meeting of the Chemical Society, I asked Dr. Frankland whether the comparative experiments on our method of water analysis as contrasted with his own method had been carried out on natural or on artificial waters. Your report, however, omits to give his reply.

It was, that *natural*—not artificial waters had been used. Inasmuch, therefore, as the amount of nitrogenous organic matter present in these natural waters is an unknown quantity, the fact that Dr. Frankland's numbers are not parallel with our own, leaves the question of correctness entirely untouched.

Had artificial waters (*i.e.*, waters into which known quantities of organic matter had been put) been taken, the contrast would have borne a different construction.—I am, &c.,

J. ALFRED WANKLYN.

London Institution, January 25th, 1868.

To the Editor of the Chemical News.

SIR,—In reference to the report of the last meeting of the Chemical Society, which appeared in the CHEMICAL NEWS of the 24th instant, I beg to state that I did not say that in employing Messrs. Wanklyn, Chapman, and Smith's method I calculated the nitrogen as albumen, or used their process as a means of control.

What I did say was in effect that the process was found to give valuable information as to the character of waters, and that the results were in accordance with their known history.—I am, &c.,

WILLIAM THORP, JUN.

THE LATE LUNAR ECLIPSE.

To the Editor of the Chemical News.

SIR,—In a recent number of your valuable journal you inserted a notice of the *Proceedings* of the Manchester Philosophical Society. Among other matters, this contained a paper by Mr. A. Brothers, on the late lunar eclipse. In his paper Mr. Brothers expresses his surprise that I had stated in a letter I sent to the *Astronomical Register* that I saw no colour on the darkened part of the limb of the moon, while he himself distinctly saw colour with a refracting telescope.

In a paper I have read at the Royal Astronomical Society I have furnished an explanation of these apparently contradictory observations.

As this explanation can scarcely fail to be of interest to many of your readers I should feel greatly obliged by your inserting the paper in your journal.[*]—I am, &c.,

JOHN BROWNING.

Upper Holloway, Jan. 1st, 1868.

OZONE.

To the Editor of the Chemical News.

SIR,—The following is an account of the development of atmospheric ozone in October, November, and December.

In October there were large amounts of ozone on the 2nd, aft. of 16th, and morn. of 17th; considerable amounts on 29th and 30th; very little on 5th, 9th, 11th, morn. of 12th, 19th, and morn. of 28th.; no ozone on aft. of 1st, aft of 10th, aft. of 12th, 13th, aft. of 15th, aft. of 18th, 20th, 22nd, morn. of 23rd, and aft. of 25th.

In November, large amounts on 16th, 17th, and 18th; considerable quantities on 13th and 14th; very little on aft. of 1st., morn. of 9th, 11th, 15th, 21st, 23rd, 24th, 26th, and 27th. No ozone on aft. 2nd, 3rd, aft. of 7th, 8th, aft. of 9th, 19th, 20th, 22nd, 25th, and 28th.

In December, large quantities on 15th and 17th; considerable amounts on 3rd and 9th; very little on 5th, 6th, 11th, 12th, 14th, 23rd, 25th, 30th, and 31st. No ozone on 4th, 8th, 10th, 20th, 26th—29th.

During November and December the development of ozone has been very scanty.

During the past year the greatest development of ozone in January occurred on the 5th, 6th, 7th, 20th, 22nd, 23rd, and 29th; in February, on the 5th, 6th, 16th, and 26th: in March on the 25th, morn of 27th, and aft. of 30th; in April, on the 4th, aft. of 8th, morn. of 9th, aft. of 10th, and morn. of 11th; in May, on the morn. of 14th, 15th, aft. of 21st and 25th; in June, on 5th, 6th, 7th, aft. of 8th, 24th, aft. of 25th, 26th, aft. of 27th and aft. of 28th; in July, on aft. of 3rd, 14th, 15th, and morn. of 16th; in August, on aft. of 5th, morn. of 6th, morn. of 7th, 12th, 13th, 17th, morn. of 18th, and aft. of 20th; in September, on aft. of 2nd, 4th, 5th, 6th, morn. of 7th, aft. of 14th, aft. of 17th and 18th; in October, on 2nd, aft. of 7th, aft. of 16th, morn. of 17th, and 29th; in November, on 13th, 14th, 16th, 17th, and 18th; in December, on 3rd, 9th, 15th, and 17th.

I should state that in almost every instance the test-papers were freshly prepared immediately before exposing them to the atmosphere,—I am, &c.,

R. C. C. LIPPINCOTT.

Bournemouth.

MISCELLANEOUS.

Dr. Jelf.—In consequence of the meditated retirement of Rev. Dr. Jelf from the Principalship of King's College, London, a subscription is being organised by his admirers, including past and present students of all departments of the College, for the purpose of presenting him with a testimonial, which we hope will be worthy of the dignity of this vast institution in its extent and aims. It is computed that between 10,000 and 20,000 living men, mostly engaged in professions, have here received their education. Subscriptions will be received by the Hon. Treasurer, Henry Worms, Esq., Captain of the King's College Rifle Volunteer Corps, 15, St. George's Place, S.W.; or at the London and Westminster Bank.

The Influence of Chemical Knowledge on Sugar Manufacture.—*The Produce Markets Review* says:—Of all countries England is the most interested in sugar, not only as the greatest consumer, but as owner of some of the richest producing countries in the world, yet no nation displays greater ignorance or apathy with regard to this subject. Like the Lotos eaters, we are content to listen to the distant waves of progress, confident that the protective system of sugar duties will keep the boundaries of our fool's paradise inviolate. But the old proverb, "Where ignorance is bliss 'tis folly to be wise," has certainly no application to commercial matters, for the country that remains in ignorance, whether it be from choice or from indifference, is sure to fall into the rear. In no part of the world is scientific knowledge on mechanical subjects turned to such practical account as in England, and many of our greatest men have made science the handmaid of commerce by applying scientific discoveries to the purposes of every-day life. The telegraph, and more recently the aniline dyes, and Bessemer's iron-working process, are a few instances among many; but sugar, of which the manufacture is completely a chemical process, is entirely overlooked by our *savans*—and yet there is a wide and almost unlimited field for chemical science in perfecting sugar manufacture, which has hardly advanced from its barbarous infancy of crushing mills, windmills, and open pans. The problem of sugar making, which has yet to be solved, is this:—To extract all the saccharine matter as it exists in the cells—that is in a pure condition, and white in colour—without extracting the injurious salts or acids which co-exist side by side with the sugar, and to do this at as small an expense as possible. A problem scarcely less important is the power of detecting by chemical analysis the exact proportion of extractable saccharine matter in any sample of sugar, for it must be observed that the per-centage of extractable saccharine matter is a very different thing from the saccharine strength shown by the polarising saccharometer. We do not hesitate to say, that any chemist who would solve these two problems would render a service to the sugar world of similar importance to that rendered to the world at large by the discovery of the steam engine. While our English chemists are mute upon the subject, the ablest chemists of France and Germany have for the last eighty years been employed in solving the delicate problem of the crystallisation of sugar, and the result of their labours, so far, may be seen in the vast continential beet-sugar crops, which are entirely due to the labours of a generation of chemists which has hardly yet passed away."

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[*] See page 55.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Bulletin de la Société Industrielle de Mulhouse.
September, 1867.

J. Kolb, "On the Absorption of Carbonic Acid by some Oxides." Jundt, "Report on Braun's Carbon Process for obtaining Photographic Facsimiles of Sketches and Cartoons." A. Dollfus, "On Cadmium and its Industrial Uses." Dollfus, "On the Use of Cadmium as a Substitute for Bismuth in the Metal Plates for printing Fabrics." G. Schaffer, "Report on Pernod's new Extract of Garancine." Kuhlmann, "On some Methods of Fixing the Gases of Stables and of using them as Manure." Sace, "On the Use of Benzine for Extracting the Colouring Matter of Garancine and other Dyes." "On the Use of German Silver for the Manufacture of Watch Cases in Switzerland." Kuhlmann, "On the Action of Water on Lead."

Génie Industriel.
September, 1867.

Dupuy and Turpin, "An Improved Retort for Distilling Resins, and for Preparing the Oil so obtained for Lubricating Purposes."

October.

D. Savalle and Co., "Apparatus for Distilling and Rectifying Alcohol." De Lapparent, "Note on a New Process for Charring Timber." Weinberger and Laffourcade, "A Portable Apparatus for the Manufacture of Alcohol from Refuse Grapes." A. E. Rudberg, "An Improved Method of Manufacturing Nitroglycerine and of Exploding the same in Blasting Operations." Cholet, "A Solder for Aluminium Bronze."

Comptes Rendus.
October 28, 1867.

Payen, "On the Use of Osmose in the Manufacture of Sugar." E. Chevreul, "A Comparative Examination into the relative Facility with which French and Japanese Silks take the Dye." A. Poey, "Remarks on the Ozonoscopic Colourations obtained with the Jame Test, and on Bérigny's Ozonometric Scale." Le Verrier, on the same subject. Chevreul, "Observations on the Discrimination of Colour *apropos* of Poey's Paper."

Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften zu Wien. (Mathematisch-Natur-wissenschaftliche Classe.)
May, 1867.

A. F. Reibenschuh, "On Crystallised Ankerite from Erzberg, Upper Styria." F. Ullik, "Researches on Molybdic Acid and its Salts." Gottlieb, "Analysis of the Emma Spring at Gleichenberg, Styria." W. F. Gintl, "On the Volumetric Estimation of Soluble Ferrocyanides and Ferricyanides by Means of Chamæleon Mineral." A. Brio, "Researches on the Optical Properties of Oxalate of Ammonia, Bitartrate of Soda, and of Formiate of Copper and Strontia." E. Brucke, "On the Behaviour of some Albuminoid Substances towards Boracic Acid."

June-July.

A. Lielegg, "On the Spectrum of the Flame of Bessemer Converters." F. Rochleder, "On Æscigenine, and on some Allied Substances—Caincine and Chinovine." H. Allemann, "Chemical Analysis of the Waters of the Mineral Spring at Ebriach, Carinthia." J. Wolff, "Chemical Analysis of the Mineral Spring at Sztojka, Transylvania." M. Erofejeff, "Researches on the Optical Properties of Sulphate of Iron." S. Konya, "Chemical Analysis of the Spring at Baden, near Vienna." E. Brucke, "On the Structure of the Red Corpuscles of the Blood." F. Rochleder, "On Saponine." S. Mayer, "On the Quantity of Fibrine separated from Blood during Coagulation." L. Pfaundler, "On the Capacity for Heat of the Hydrates of Sulphuric Acid." F. Ullik, "On some Compounds of Tungstic Acid." H. Allemann, "On the Chemical Composition of Maize Oil." W. Baxt, "On the Physiological Action of some Alkaloids contained in Opium." E. Ludwig, "On the Presence of Triethylamine in Wine."

NOTES AND QUERIES.

Dyeing Black.—Could you kindly inform me of the best method for dyeing a good black for polishing, and the best means to dye the yarn through.—R. B. C.

Yellow Chromate of Lead.—Can any of your correspondents give me a process for preserving, with its original lemon tint, yellow chromate of lead in paste. The method of precipitating with excess of sulphate of lead is unsatisfactory.—A. C. B.

Oxychloride of Magnesia.—I am engaged in a business connected with the use and preparation of cements in the building trade, and would thank any of your numerous scientific friends to inform me where I might find cheaply a crude carbonate of magnesia suitable for making oxychloride of magnesia for siliceous cementation, and a few hints as to the best mode of its preparation and use.—J. E. Hamilton.

Free Sulphuric Acid.—A corespondent in your last issue desires a process for the estimation of "Free Sulphuric Acid in Superphosphates." I have much pleasure in assisting him. The following is a method which I have frequently tried, and is satisfactory for the purpose. A water solution of the manure being made, evaporate slowly until a small quantity only is left: add about seven volumes of concentrated alcohol, and allow to settle in the cold for some hours. This precipitates all sulphates, and leaves in solution, besides phosphates, the free sulphuric acid. Filter, wash with alcohol, add a large amount of water to the solution, and carefully evaporate off the spirit, and estimate the acid by baric chloride, &c. The soluble phosphates do not in any way interfere.—R. Carter Moffat, Ph. D., Glasgow.

Weights and Measures.—Now that foreign weights and measures are so much used in scientific books, it would be be a great advantage to those who like myself are not very conversant with the value of these figures, if one of your clever mathematical correspondents would calculate and publish in your columns some simple factors whereby kilogrammes could be converted into cwts. and tons, francs into shillings and pounds sterling, grammes into ounces, metres into feet and yards, &c., &c., by a simple process of multiplication.—Ignoramus.

TO CORRESPONDENTS.

Enquirer asks for the best work treating on the combustion of coal in furnaces.

Student.—See Dr. Miller's lectures on spectrum analysis, reported two years ago in this journal. No special book on this subject has yet been published in England. A very good one in Dutch was written some years ago by M. Dibbits, and reviewed in the Chemical News.

J. T.—Mix the crude paraffin with paraffin oil, benzol, or coal naphtha.

T. D., an Old Subscriber.—Toluidine is a regular article of commerce now; almost any aniline maker, or dealer in coal tar products will supply it. It is made by mixing toluol with nitro-sulphuric acid, and reducing the resulting nitro-toluol with sulphide of ammonium or iron and acetic acid.

Rusticus.—1. We believe Dr. Crum Brown first brought his system of graphic notation before the Royal Society of Edinburgh. 2. The researches are given in the Journal of the Chemical Society. They are not thought much of by chemists. 3. Not except through a member.

W. P. B.—A letter is waiting for you at our office. Please forward your address.

Communications have been received from J. Horsley (with enclosure); M. Jannsen; Dr. E. Röhrig (with enclosure); Messrs. Townsend and Adams, New York (with enclosures); W. Ercot Smith; F. A. Aramayo; O. Coke; J. Dalmeira; H. P. Dobson (with enclosure); Messrs. Johnson and Matthey; J. E. Hamilton; A. Hochstetter; E. Jones; J. Cliff; T. R. Fraser, M.D.; Dr. Sansom; T. W. Lovibond; H. Lowe; Dr. H. Sprengel; K. Rumball (with enclosure); Karl Hoffman; W. Wyatt (with enclosure); Captain W. A. Ross; Dr. F. C. Calvert, F.R.S.; D. Marples (with enclosure); W. Hall (with enclosure); J. A. Wanklyn; A. P. Price; W. Thorp, junior; W. E. Drysdale; Dr, Watts (with enclosure); W. J. Day; J. Muspratt and Sons (with enclosure); F. W. Hart; N. Earle; Professor Tyndall, F.R.S.; J. E. Thorpe; H. Bower; Dr. R. C. Moffat; G. Gore, F.R.S. (with enclosure); Rev. B. W. Gibsone, M.A. (with enclosure).

MEETINGS FOR THE WEEK.

Monday.—Royal Institution, 2. General Monthly Meeting.
— Medical, 8.
— Society of Arts, 8. Cantor Lectures. "On Food," by Dr. Letheby.
Tuesday.—Royal Institution, 3. Professor Tyndall, "On the Discoveries of Faraday."
Wednesday.—Society of Arts, 8.
— Geological.
— Pharmaceutical, 8.
Thursday.—Royal Institution 3. Professor Tyndall, "On the Discoveries of Faraday."
— Royal, 8½.
— Chemical, 8. "On Gas Analysis," by Dr. W. J. Russell.
— Royal Society Club, 6.
Friday.—Royal Institution, 8. Professor Huxley, "On Animals intermediate between Birds and Reptiles."
Geologists' Association, 8.
Saturday.—Royal Institution, 3. Professor Roscoe, "On the Non-Metallic Elements."

PRACTICAL CHEMISTRY.
Laboratory, 60, Gower Street, Bedford Square, W.C.

Mr. Henry Matthews, F.C.S., is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its Application to MEDICINE, AGRICULTURE, and COMMERCE.

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Methylated Spirits.—David Smith Kidd, Licensed Maker, Commercial Street, Shoreditch, N.E. Also, FINISH, FUSEL OIL, and RECT. NAPHTHA.

CANDLES, GLYCERINE AND SOAP. A Gold Medal was awarded at the Paris Exhibition to Price's Patent Candle Company, Limited, for "Candles, Glycerine, and Soap"—the only one to any British Exhibitor for these three things combined. The chief Candles of the Company are their "BELMONTINE" and "PRICE'S PARAFFINE" for those who must have the extreme transparency of pure Paraffine; their GOLD MEDAL PALMITINE" and "SHERWOOD PALMITINE" for those who, while desiring candles of great beauty, require also steady brilliancy of light and freedom from smoke and smell; their good old-fashioned "BELMONT SPERM AND WAX," and "BEST," "No. 2," "No. 3," and "BATTERSEA" COMPOSITES for those who require only perfect burning without caring for transparency; and their "CHAMBER" Candles, hard, and of small diameter to avoid the dropping of grease when carried. Their new toilet soap, "PRICE'S SOLIDIFIED GLYCERINE" contains half its weight of their distilled Glycerine, and should be the one toilet soap in use, especially in winter, because of its admirable effects in preventing chapping of the hands and face. There ought also to be in every house one of the sealed bottles of their patent distilled Glycerine, known everywhere as "PRICE'S GLYCERINE," two or three drops of which, mixed with three or four times as much water, will in a day or two remove chapping and roughness of skin, whether of adults or children; and when this is effected, a single drop of the undiluted Glycerine applied once a day will prevent the recurrence of the chapping and roughness. Insist on having "Price's Glycerine" in the Company's own sealed bottles, quantities of cheap impure Glycerine being now sold in the shops because of the low rate at which the dealers can buy it in comparison with Price's. All the good medical authorities abroad as well as at home order "PRICE'S" as the one only Glycerine to be used.

"PRICE'S NEW PATENT NIGHT LIGHTS" for burning in the wide glasses, are believed to be the very best Night Lights made. "PRICE'S CHILD'S NIGHT LIGHTS" are known everywhere and are excellent for burning without a glass.

Water-glass, or Soluble Silicates of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S, Ardwick Chemical Works, Manchester.

THE OXYGEN TREATMENT.
Three Great Exhibition Prizes;—
The Medal, London, 1862; Silver Medal and Hon. Men., Paris, 1867; Medal of "International Society for Aid to the Wounded in War."
CONDY'S PATENT FLUID,
For Remedial Purposes (under Government Medicine Stamp),
Is used in all the Principal Hospitals,
For Wounds, Sores, Ulcers, Burns, Sore Throats, Discharges, &c.
From many Hundreds of MEDICAL Reports:—

"Almost in despair of saving my patient, I prescribed a gargle containing CONDY'S FLUID. The improvement was so rapid that it could be due to the gargle only."—On Diphtheria, by N. Evans, M.D.; *Medical Times & Gazette, Oct. 27, 1866.*

Sold by J. Bell and Co., 338, Oxford Street, and most Chemists. Prices:—1s. 1½d., 2s. 9d., and 4s. 6d. Must be of crimson colour with Prize Medal on label, and Gov. Med. Stamp. Wholesale at the Chemical Works, Battersea, London.

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OPTICIANS, &c., TO HER MAJESTY,
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(Four doors from St. James's Street), Late of 43, Piccadilly.
MURRAY AND HEATH'S IMPROVED SEA-SIDE POCKET MICROSCOPE, with or without Tripod Stand.

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"The results have been very remarkable, for they show an average increase of 63 per cent on the illuminating power of the gas. I am of opinion, therefore, that the invention is of great practical value." Price One Shilling each for Fish-tail Burners. To be had retail of Gas-fitters and Ironmongers, and (wholesale only) of JOHN SCHOLL, 41 and 42, Berwick Street, Oxford Street, London, W. Terms on appcation. N.B.—A specimen sent free on receipt of 12 stamps.

Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c.
TO PHARMACEUTICAL AND OTHER STUDENTS.

Mr. J. C. BRAITHWAITE, for thirteen years Principal Instructor in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c., wishes to inform his old Pupils and others that he continues to devote his whole attention to Education. The Session 1867–1868 will commence on the 1st of October, when

Mr. BRAITHWAITE'S Laboratory, which has been enlarged during the recess, will be re-opened at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS meets as usual every Monday and Thursday Evening, at 8 p.m., commencing October 3rd.

The LATIN CLASS for the reading of the Pharmacopœia, Physicians' Prescriptions, &c., every Tuesday and Friday Evening, at 8 p.m., commencing October 1st.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday Evening, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will commence at 10 a.m., October 2nd.

Fee to either of the above Classes Half-a-Guinea per Month; to the Botanical Excursions only, Half-a-Guinea per Eight Lessons, payable in advance. Pupils can enter at any period.

Address, 54, Kentish Town Road, N.W.
Mr. Braithwaite receives a few Pupils to board in his house.

Mr. J. Tennant, Geologist, 149, Strand, London, W.C., can supply Elementary Collections of Minerals, Rocks, and Fossils, to illustrate the Works of Ansted, Lyell, Jukes, and others, on the following terms:—

100 Small Specimens, in Cabinet with Three Trays	£2	2	0
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More extensive Collections, either to illustrate Mineralogy or Geology, at 50 to 500 Guineas each, with every requisite to assist those commencing the study of these interesting branches of Science, a knowledge of which affords so much pleasure to the traveller in all parts of the world.

In the more expensive Collections some of the specimens are rare, and all more select.

THE CHEMICAL NEWS.

Vol. XVII. No. 427.

CRYSTALLOGRAPHY AND THE BLOWPIPE.

II.

By CAPTAIN W. A. ROSS, R.A.

As Professor Richter and several other operators have found some difficulty at first in blowing the vesicles described by me, I ask your permission to commence this paper with an explanation of their formation.

Method of Blowing Vesicles of Borax, Soda, or Phosphorus Salt.

a. **Borax.**—This being the most cohesive and least deliquescent of the three fluxes, requires no addition to enable a strong vesicle to be blown, which will last for weeks or months. The platinum wire should be twisted into a ring over one of the legs of a pair of the *round* pliers used by bird-cage makers; the ring is then nearly perfect, and should have the diameter of a largish pin's head. The other end is then placed in a holder, the wire heated, and a bead of borax taken up, which should be *perfectly clear* on cooling. This bead is then heated again, and charged with the substance. If a silicate, the bead will be observed to become much less fluid, and to move heavily round under the influence of the O.F.[*] like a thick jelly. After a little practice the operator will find it the best way to hold the ring of the platinum wire nearly horizontal to the table, so that the greater part of the fluid bead hangs downward, because by blowing *upward* through this there is not only less chance of bursting the vesicle, but the colouring matter (if any) will accumulate better round the ring, where the borax is generally thickest. I always now use the *geblase*, or caoutchouc bellows,[†] with the aid of which, in heating the beads, I can easily blow thirty vesicles in a couple of hours, and could make them in one if the minerals or oxides were ready and powdered. The bead should be held in a strong O.F. or R.F., according to the condition in which the substance is required. It should be allowed to cool down to red heat, and then the jet of the blowpipe applied close to, but not touching it, and square to the ring of the wire. Siliceous vesicles (which are, in fact, glass) are easily made, but they require to be annealed by being held near the flame for a short time after, for if suddenly withdrawn, large pieces will crack out of them. As the strength of the blast from a mouth blowpipe does not vary much, the *size* of the vesicle is not under the operator's control, and can only be partially regulated by the quantity and density of matter in the bead. Two beads of apparently the same size and density will, however, sometimes give vesicles of different dimensions, in which case the smaller will always be found to have a greater quantity of the flux round the ring of the wire.

The bead may be charged with the substance until perfectly opaque; for however saturated it may be, the vesicle will always be blown out clear. Even cobalt and manganese only give faint coloured lines of blue and pink over the *vesicle*, however much the *bead* may have been charged, but the exposition of undissolved matter is so delicate in the former that what may have seemed merely a thick opaque solution in the latter, appears in the vesicle as a number of spots or particles of extraneous matter, some of which look formidably large under the microscope. The merest particle of reduced metal is so discernible in this way, that I have amused myself by holding a green bead of the oxide of copper in the R.F. until it was apparently quite clear, and then, blowing it into a vesicle, I invariably found, with a microscope, a particle of metallic copper. I have now a vesicle of chromate of iron two inches long by one wide, made from an "opaque" bead, covered in this way with spots of the undissolved ore.

The vesicles, as made, should be placed in a tray on cotton, and a record *immediately* written of each of them, numbering from the right. If this is omitted, or a vesicle is misplaced, its contents are forgotten, and the only resource is to shake off the re-heated bead, and make a new vesicle.

b. **Soda** and **Phosphorus Salt** vesicles are made in exactly the same way as those of borax; but a small proportion of silicic acid must be added, without which the soda vesicle cannot be blown at all, and, even then, both of them deliquescing, will not last more than a short time.

I now proceed to record a few observations on the borax vesicles, which, I think, will be found to be based on certain *fixed* principles.

1. A vesicle clouding over with an unctuous-looking white film within an hour or so of being made, and showing (under the microscope) small deliquescent drops outside, may be set down as containing an alkali in considerable proportion, combined with little or no silicic acid. (N.B. I hope to be able soon to distinguish between soda and potash, the former appearing to crystallise in flowers or leaflets, the latter in stars.)

2. A vesicle clouding over with a *dry* white film after a few hours, and not deliquescing at all, or not for several days, contains one of the alkaline earths. Of these, *baryta* may be at once recognised by the peculiar blue-white appearance of the new film, which has much the colour of a solution of sulphate of quinine.

3. These films, however slight they may appear at first, are evidently due to the aggregation of minute crystals, which are, in the first instance, not distinguishable by the most powerful pocket lens.

4. After the first day or two, an immense number of similar crystals generally cover the surface of the vesicle, those apparently containing metallic acid salts, having a curious resemblance to the annular rings of a section of exogenous wood, but in no two differing vesicles are these crystals exactly alike. Over these, after the lapse of another day or two, a fresh kind of crystal sometimes appears, smaller and much fewer in number than the first. If I might venture a surmise regarding this phenomenon, it would be that the *first* are crystals of the double borates of the metallic oxides, the *second*, some combination of the latter with CO_2 derived from the atmosphere.

5. A vesicle of *boro-silicate of soda* remains quite clear for several days, and as far as I know yet, does not crystallise.[*] It is therefore the best vehicle I know for the vesicular exhibition of crystals of substances contained in it.

6. Vesicles of *silicate of soda* deliquesce a few minutes after formation, and those of P. salt in a little longer time, but the most curious phenomena are those exhibited under the magnifying glass by vesicles of silicate of potash, which cloud over and deliquesce as soon as formed, the crystals, scarcely discernible, appearing like small white rings with a black centre; the deliquescent moisture at the edges shrivelling up the vesicle, and advancing on all sides *towards the centre of gravity* like a miniature wave. The crystals of soda silicate appear formed like small white flowers with four petals.

The above may, I think, be depended on as a ground work for careful examination, but when I came to attempt to reduce my observation to system, making sketches of the crystals as I proceeded, I found, that independently of requiring the pencil of a Redgrave or Millais to copy the beautiful forms examined, I might as well begin to write a perfectly new work on crystallography, every second page of which would require to contain elaborate illustrations! The field is immense, and requires many and careful observers, for although the whole effects are evidently due to the operation of definite laws—

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[*] Oxidating flame.—Initials will be used to save space.

[†] This ingenious and portable bellows is the invention of an American student at Freiberg. It is described and figured in Richter's last edition of Plattner's work.—Leipsic, 1865.

[*] This vesicle, made of a mixture of borax with one-third of silicic acid, eventually crystallised after a period of three weeks. The crystallisation is interesting as a type of SiO_2. I apply the term *grammate* to it from its similarity to a series of lines or letters.

> "A mighty maze, but not without a plan,"

the clues cannot be followed successfully by one or even by few observers. Every metal with its salts appears like a kind of mineralogical kaleidoscope, throwing its crystallisations apparently at random into the most elegant shapes, each of which must be made to yield its atom of information as to the source of all. But when I proceeded to examine crystallised vesicles of the alkaline and earthy silicates, as *albite*, *adular*, *calcite*, *heavy spar*, &c., I could really, with little imaginative aid, fancy myself beholding scenes in fairy land. The beautiful snow crystals pictured in the Chemical News in illustration of Professor Tyndall's lecture, are tame compared to these. Given a candle, a powerful pocket lens, and these vesicles, and you have objects of exquisite beauty, before which the most brilliant gems in the fairest setting of silver or gold must "pale their ineffectual fires." Taking the platinum wire carefully in a pair of fixing pliers and holding the vesicle between your eye (applied to the magnifying glass) and the light, you behold the most delicate tracery of fronds, flowers, ferns, or winter trees, standing out in frosted silver against a flood of golden light. Sometimes the appearance is that of a Cashmere shawl elaborately worked in silver (*calcite*), but the mineral *cerite* seems to afford forms even more exquisitely beautiful than these. I cannot attempt to describe the appearance of the *cerite* crystals, unless sprigs of the maiden hair fern elegantly posed together and covered with frosted silver on a ground of clear glass, can afford some idea of them.

It may be said these crystals are possibly pretty, but what is the use of them? I answer, that if friendly *collaborateurs* will assist me, I hope to turn them to a very distinct use. Already I can distinguish by means of them with tolerable certainty, an alkali or alkaline earth, isolating one—baryta,—and this you will recollect is at present the weakest part of blowpipe analysis. If I had space, I should much like to inform you of some remarkable vesicular reactions afforded by *molybdenite*, which, with the result of ulterior experiments, would appear to place that metal in close relation to the "earths," but I must reserve such remarks for another paper. In the meantime, why should not balls of fluid glass, containing substances in solution, be blown into globes of sufficient tenuity to favour crystallisation, and thus form permanent and beautiful models in illustration of one of the queens of earthly science—crystallography?

THE MICROSCOPE IN GEOLOGY.

By DAVID FORBES, F.R.S.

An interesting paper on this subject, by Mr. David Forbes, F.R.S., appeared in the *Popular Science Review* for October last; from it we condense the following. The original article is illustrated with numerous coloured diagrams of rock sections, as seen under the microscope.

The more searching and exact method of investigation now demanded by the advancing state of geological inquiry, necessitates that the student of that science shall in his researches avail himself of all possible means which the collateral sciences place at his disposal; and, amongst others, of those which can enable him to extend his powers of observation beyond the limits to which his unassisted eyesight can convey him.

The application of the microscope in geological inquiries is as yet, however, quite in its infancy, for with the exception of Sorby's invaluable memoirs on some special points of inquiry, literally nothing has as yet been made public which could even serve as an introductory guide to the geologist who might wish to commence the study of the subject.

In the present communication it is intended, as far as the space at disposal will allow, to attempt a short sketch of some of the results already obtained, in order thereby to illustrate the use of the microscope in similar inquiries.

When applying the microscope to the examination of rock structure and composition, it is necessary to prepare the specimens previously, in order to be enabled to make full use of transmitted light in their investigation.

When in sufficiently thin splinters or laminæ, by far the larger proportion of mineral compounds allow light to pass through them with more or less facility, and amongst these, most silicates, chlorides, fluorides, carbonates, sulphates, borates, and other salts; as well as many oxides, and some few sulphides, sulph-arsenides, &c. On the other hand, all native metals, alloys, and most of their combinations with sulphur, arsenic, antimony, &c., along with some few oxides, and other compounds, are opaque, even when in the thinnest laminæ, and consequently when present, as they often are, in minute quantity in rocks, although sometimes recognisable by their external crystalline form, are not to be distinguished by their optical properties, as in the case of those bodies which, as before-mentioned, are translucent.

When a mineral or rock under examination is entirely in the vitreous state, as, for example, obsidian, it appears when viewed under the microscope, merely as a more or less transparent or coloured glass, presenting, if perfectly in the vitreous condition, no evidence of crystalline or other structure, except, perhaps, traces of the striæ of viscid fusion. It is usually found, on inspection, however, that some part of the mass is sufficiently devitrified to allow of its structure and mineral composition being recognised. In some cases, when the glassy appearance presented to the eye would discourage any hopes of structure being discovered, the microscope proved the reverse most conclusively.

In many cases, however, where the specimens are so perfectly in the vitreous state as to show no trace of structure whatsoever, this may be developed by carefully acting upon the surface by gaseous or liquid hydrofluoric acid.

The rock sections may be prepared for the microscope as follows:—A fragment, from one-quarter to three-quarters of an inch square, and of convenient thickness, is chipped off the rock specimen in the direction of the required section, and ground down upon an iron or pewter plate in a lapidary's lathe with emery, until a perfectly flat surface is obtained. This surface is then worked down still finer by hand on a slab of black marble, with less coarse emery, then upon a Water of Ayr stone with water alone, and, lastly, finished by hand with water on a slab of black marble. This side of the rock is now cemented by Canada balsam on to a small piece of plate glass about 1¼ inch square and ¼ thick, which serves as a handle when grinding the other side on the emery plate as before; this grinding is continued until the section is so thin as to be in danger of breaking up from the roughness of the motion, upon which it is completed, by further grinding with emery by hand on marble, and finished first upon Water of Ayr stone with water, and afterwards upon black marble, as before described. The section is now removed from the plate-glass, and mounted in Canada balsam on a slide, covering its upper surface with a thin glass as usual.

The thickness to which such sections need be reduced is, of course, entirely dependent upon the transparency of the rock constituents, and is commonly from 1-100 to 1-1,000 of an inch.

Thin splinters of rocks and powdered fragments, mounted in Canada balsam, may also be examined with advantage, but cannot replace the above-described sections.

The examination of such a rock section enables a mineralogical analysis to be made, even of the most compact and apparently homogeneous rock, and generally leads to the discovery of other mineral constituents previously unsuspected, from their being invisible to the eye, and also, as Sorby has observed, allows those minerals, formed at the time of solidification of the rock, to be distinguished from such as are the products of subsequent alteration.

Arranging rock species according to their structure, it will be found that most rocks fall naturally into one or other of two great classes—

I. PRIMARY OR ERUPTIVE ROCKS;
II. SECONDARY OR SEDIMENTARY ROCKS;

and it will be seen that the microscope is of special value when applied in cases where the external appearance renders it doubtful as to which of these classes a rock may pertain.

The terms *primary* and *secondary* are here used quite independently of geological chronology.

I. Primary or Eruptive Rocks.

This class includes rocks which have made their appearance in many, if not in all epochs, from the most ancient to the most recent, from the old granitic outbursts to the eruptions of the now active volcanoes; and if, as is now generally admitted, the earth be regarded as having been once a molten sphere, the consolidated original crust of the globe would pertain to this class of rocks.

Mineralogically they consist of crystallised silicates, with or without free quartz, and usually containing many other minerals in minor quantities, especially metallic compounds, as magnetite, titanoferrite, iron pyrites, &c., which last are frequently present in so minute a quantity as only to be detected by the microscope.

Whatever be their geological age, or from whatever part of the earth's surface they be taken, the microscopical inspection of such rocks shows immediately that they possess certain general and definite structural characters, distinguishing them at once from all other rocks.

The mineral constituents of such rocks are seen to be developed as more or less perfect crystals, at all angles to one another, thereby indicating that the entire mass must have been at one time in a state of liquidity or solution (aqueous or igneous), sufficient to allow of that freedom of motion absolutely essential to such an arrangement of the particles.

The microscopic examination already made of many hundred sections of eruptive rocks, differing widely in geological age and geographical distribution, shows that in all rocks of this class, whether of the most compact, hard, and homogeneous appearance, or occurring in the softest and finest powder, like the ashes and dust frequently thrown out by volcanoes; a similar crystallised arrangement and structure is present and common to them all. Lavas, trachytes, dolerites, diorites, porphyrites, syenites, granites, &c., all possess the same general structural features, serving to distinguish the eruptive rocks as a class from all others.

In the examination and discrimination of the minerals which compose these rocks, especially when close-grained, the microscope is quite indispensable, since without it no such inquiry could be attempted. In these examinations, the assistance of polarised light is most valuable; but the space, unfortunately, only allows of a mere mention of its application. In distinguishing dolerites from diorites, when fine-grained, as is often of considerable geological importance, the fibrous structure of the hornblende of the latter is generally so well developed, even when present in very minute quantity, as to distinguish it readily from the augite of the former, which possesses no such structure. Even in the case of Uralite, a mineral characteristic of certain porphyritic rocks, which has the external form of augite, although its chemical composition is that of hornblende, the fibrous structure characteristic of hornblende is distinctly visible. The microscopic structure of some minerals, however, varies with their origin; thus Sorby has shown that the structure of augite, and some other minerals in meteorites, is quite distinct from that of the same minerals occurring in eruptive rocks, and demonstrates, in a very striking manner, how the study of such peculiarities is likely to clear up the mystery in which the origin of these bodies is involved.

When, as is often the case, especially with translucent, colourless minerals like quartz, leucite, calcite, felspar, &c., the appearance presented under the microscope is alike, their optical properties and the use of polarised light afford the means of distinguishing between them with certainty; as, also, in the event of one substance being present under two forms, as calcite from aragonite, monoclinic from triclinic felspars, &c. In a similar manner, the structure, whether crystalline or vitreous, is determined, and valuable information obtained, elucidating the mode of formation and origin of the rocks themselves.

The alterations produced in eruptive rocks, subsequent to their solidification, by the action of water, atmospheric, or other agencies, are studied with advantage under the microscope.

Before proceeding to the next class of rocks, the discovery by Sorby of the numerous minute fluid cavities in the quartz of granites should be alluded to, as proving the great value of the microscope in the study of these rocks. The result of this gentleman's researches* proves that granites have solidified at a heat far below the fusing points of their constituent minerals, and at such a pressure as to enable it to entangle and retain a small amount (¼ to ½ per cent) of aqueous vapour, which naturally must have been present during its liquefaction. The presence of these fluid cavities in the quartz of granite was immediately blazoned forth as proof positive of the non-igneous origin of granite; whereas if Mr. Sorby's memoir had actually been read, it would have been seen that he had found fluid cavities, perfectly identical with those in granite, not only in the quartz of volcanic rocks, but also in the felspar and nepheline ejected from the crater of Vesuvius; and that the presence of fluid, vapour, gas, and stone cavities, are common both to the volcanic quartz-trachytes and to the oldest granites; and the inference drawn by Mr. Sorby from the results of his researches is that both these rocks were formed by identical agencies. He, therefore, classes them together under one head as rocks of similar origin.†

(To be continued.)

Amido-acids from Chlordracylic and Chlorsalylic Acid.—H. Hübner and R. Biedermann. Chlordracylic acid is converted into nitro-compound, and reduced by means of tin and chlorhydric acid to chloramidodracylic acid $C_7H_3Cl(NH_2)O(OH)$. The latter is treated with sodium amalgam, which removes the whole of the chlorine, being thus converted into amido-acid isomeric with amidodracylic acid. Similar experiments made with chlorsalylic acid have shown that chloramidosalylic acid is distinguished from chloramidodracylic acid, although they both have the same fusing point, *i.e.*, 212°.—(*Zeitschr. Chem.*, N.F. iii. 567.)

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* Quart. Jour. Geol. Soc. vol. xiv. pp. 453—500.

† These researches tend to confirm the theory of the igneous origin of granite and eruptive rocks in general. It must not be forgotten that by *igneous action*, as used by the Plutonist, was always understood *the action of heat as developed in volcanoes* (the study of which was the basis of the theory itself), in which the agency of water was always recognised. Nearly half a century ago, Scrope not only insisted on the important part played by water in volcanic action, but specially pointed out the difference between such volcanic fusion and ordinary melting. The term hydro-igneous action might not be inappropriate for such, but hydro-thermalism does not at all express what is intended. The idea of a true dry fusion in nature exists only in the brains of the ultra-Neptunist or lukewarm hydrothermalist.

ON

HEAT AND COLD;

A COURSE OF

SIX LECTURES*

(*Adapted to a Juvenile auditory*),

DELIVERED AT

THE ROYAL INSTITUTION OF GREAT BRITAIN,

(*CHRISTMAS*, 1867—8),

BY

JOHN TYNDALL, Esq., LL.D., F.R.S.

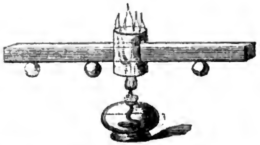
Lecture IV.

(Continued from page 54.)

Propagation of Heat.

I have now to say a few words upon another subject—the propagation of this thing we call heat—this curious quivering motion of the atoms of bodies; and in order to make this evident to you, I will, first of all, make an experiment or two on liquid bodies, or on gases. I want you to understand the manner in which heat distributes itself in gases, and, for that purpose, I have here placed a little piece of platinum wire—that metal which we raised to a bright white heat in our first lecture. It is a refractory metal, and bears a very large amount of heat. Now, we will have the room made dark, and Mr. Chapman will excite our electric lamp, and I will ask you to look at the shadow caused by this little platinum wire on the screen. I trust that even the most distant young philosopher now sees that shadow. We will heat the platinum wire by an electric current, and you will observe two things. You see, first of all, that the platinum wire gets longer—swags, sinks down—when I heat it. Observe also the air rising up from the surface of the heated wire. That wave-like motion is due to currents of heated air rising from the wire. The air when heated, rises in that way. The same is true of liquids: I have here a glass cell containing cold water, which will enable you to see this. I will place it in front of the lamp, and cast an image of it upon the screen. There is a means of warming this spiral of platinum wire within the water, and I want you to observe that the same thing occurs in water as you saw taking place with the air just now. Mr. Cottrell will now make the circuit for the electric current to pass; and then the moment the circuit is made you will find that the water will be heated by this spiral of platinum wire, and the heated particles of water will rise to the surface of the liquid. There, on the screen, you see the action of the hot wire upon the water, causing the water to rise in these *striæ*. The water goes up from the heated surface, and in time the heated particles will distribute themselves through the entire mass of the water. I make this experiment in order to fix upon your minds the difference between this action and another which resembles it at first sight. The action which I have shown you receives the name of *convection*, which I should like the elder boys to remember, and I want you to distinguish between this and another process, which is a very different one, and which is called *conduction*. In order to illustrate this subject of conduction, I have placed here before you an iron bar, and a copper bar (Fig. 6.), and I want to ask them which conducts heat best. Mr. Cottrell will now light a lamp, and place it underneath the bars, so as to heat the ends of them at the same time; and as they become hot they will liberate these little balls, which are fixed on with wax; and I think you will find that the heat will travel along the copper better than along the iron. Here is a similar apparatus, with bits of tallow candle fixed to it. The greater the number of these pieces of candle that drop away from either bar, the farther and better the heat has travelled through that body. This is almost a better experiment than the more elaborate one, and it is one which you can make at home for yourselves. The copper will be able to melt away all its candles, while the iron will not be able to do so. The whole philosophy of the clothes you wear is, that they are bad conductors of heat. Your bodies are sources of heat. Through the burning up of the food you eat, within your bodies, warmth is produced; and the object of the woollen clothes which you wear at the present cold season of the year, is simply to prevent the passage of heat from the body to the air. For this reason we clothe the body with woollen cloth, that being one of the worst conductors of heat in nature. But the cloth has no warmth in itself; if I want to keep ice cool, as I did in a former lecture, I wrap my ice in flannel, which prevents the heat from without coming to the ice. Thus the woollen cloth simply prevents the transfer of heat in either direction, and hence the value of these non-conductors as articles of clothing.

Fig. 6.



The experiment with the pieces of candle sufficiently illustrates the fact that different materials differ in their power of conducting heat. I might also show you this in another way. If I warm this piece of iron by putting it into warm water, and then place it upon a cylinder of glass which stands on the face of the thermo-electric pile, that glass does not allow the heat to pass through to the pile, and the needle still remains on the side of cold. It would be a long time before the heat of this iron passed through the glass and reached the face of the pile. I will now remove the glass and place a cylinder of copper on the face of the pile, and then put the warm iron on the copper. I suppose that not more than two or three seconds will elapse before the heat will pass by the conduction of the copper to the face of the pile, and the moment it does so you will see that the needle will come to the other side of the middle line, showing heat. Now, in this case, instead of having the heat transferred, as in liquids or gases, by the passage of hot masses through the remaining bulk, we have a transmission of heat from atom to atom of the copper; and this process, as I have said, is called *conduction* of heat, in contradistinction to the other process, which is called *convection*.

And now I have to go on to another subject of a somewhat different character; but in passing I must say a word upon a very useful piece of apparatus, the safety lamp, which, unfortunately, is not always wisely used. I will state the problem which the inventor of this simple, but very wonderful apparatus placed before him. You must know that in our coal mines the miners are prevented from using a candle to light them while at their work, in consequence of the quantity of gas which is in the air of the mines. In former times they used to employ a flint and steel, and work by the feeble light of the sparks. The problem which Sir Humphry Davy, the inventor of the safety lamp, set before him was this:—"How can I give the miner light, and still preserve him from this explosive gas?" and he thought, "Can I put a light in any way within an apparatus so that, although the light shall shine through the apparatus, the gas outside will be prevented from exploding?" He found out that a flame could not pass through a piece of ordinary iron gauze. In fact, the flame is so much cooled by the wire gauze, in consequence of iron being a good conductor of heat and carrying the heat away from the flame, that the flame cannot get through. You see that when this iron gauze (Fig. 7) is placed over the flame, the flame is entirely cut off, and cannot pass through; and if we light the gas above the gauze it will burn there, but the flame is prevented from reaching the gas below the gauze. (See Fig. 8.) Now, Sir Humphry Davy, when he made the miner's safety lamp, surrounded the candle wick or the oil wick with a wire gauze; and, although the light can pass through the meshes of the gauze, you might have an explosive mixture within and without the lamp, but the flame inside could not propagate itself to the gas outside, being unable to pass through the gauze.

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* Reported verbatim, by permission of the Author, for this journal.

Fig. 7.

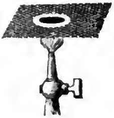
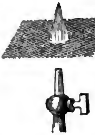


Fig. 8.



I come now to another subject, and a very interesting one. I will ask Mr. Cottrell to heat a silver crucible, or dish, almost to redness; and supposing I then pour water into it, what do you think will occur? You might at first say, "Well, the water will be converted into steam." That is not quite the case. You will find when I pour the water into the vessel that the heat of the vessel produces such an amount of vapour from the water, that the water is supported upon a spring or elastic cushion of its own vapour, and is thrown into the form of a sphere, and the water rolls about in its own vapour. In order to show you this effect, we will cause a beam of light to fall right into the silver basin, and that beam of light will illuminate the drop of water which we pour into the basin. The image of the interior will be then thrown upon the screen. We now blow in a little water.

Now you see represented on the screen the globules of water rolling about—rolling about upon a cushion of their own vapour. Sometimes in this experiment we get a most beautiful figure produced by the water. We get a rosette form of globule. The vapour breaks away from the water in a kind of musical way. We will see if we cannot get the rosette form—a crimping of the edge of the drop of water. [After a few seconds the rosette form occurred. See Fig. 9]. When the basin is not very hot, at first these little crimpings arise, and then, when the vapour is not sufficiently strong to lift the water out of contact with the basin, the water will come into contact with the basin, and will suddenly boil. There it is. [At this moment the spherical form ceased, and the water boiled up and immediately disappeared with a hissing sound.]

I must now send Mr. Cottrell down stairs to prepare something of very great interest and beauty; but as I do not know whether the experiment will succeed or not, I do not wish to raise your expectation. If, however, it succeeds, the experiment will be a very useful and a very important one.

In the meantime I want to show you what may occur in consequence of this spheroidal condition of water on a hot surface. I have here a little copper boiler (Fig. 10). I will cork this boiler up, but I intend first of all to heat it very highly indeed, and then I will place a little drop of water into the boiler. I now heat the boiler, and Mr. Chapman will hand me some hot water, and when the boiler is heated I will pour a little into it, and that water will roll about as a spheroid. Vapour will be given off, but being small in amount, while the water is rolling about it will escape through a small hole in the cork. I will then withdraw the boiler from the source of heat, and the drop of water will then come into contact with the hot boiler; steam will be generated, and I think that that steam will be sufficient to expel the cork into the atmosphere. [The experiment was performed with the result anticipated.] There you see the steam drives out the cork the moment the water becomes changed into vapour by contact with the hot surface of the boiler. In this way we may have very serious explosions, but that is a subject into which I cannot go at present.

Fig. 9.

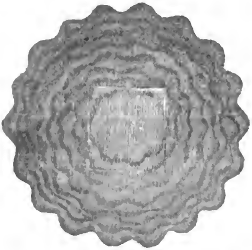
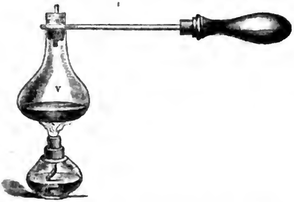


Fig. 10.



I want now to make an experiment or two which shall illustrate the character of a certain substance with which I am now going to operate. I have had occasion to mention gases several times in these lectures. Now, gases, and, in fact, the very air we breathe, are nothing more than the vapours of substances possessing very low boiling points. For instance, Mr. Faraday, to whom we are indebted for the very finest investigations upon this subject, succeeded in squeezing together the particles of the gas which is contained in this vessel, and forming it into a liquid; and there are other gases which have been liquefied by Mr. Faraday. One of them is a gas called carbonic acid, which we breathe out of our lungs. I want to generate a quantity of carbonic acid gas in this large round glass vessel. We have at the bottom of the vessel some bicarbonate of soda, and I have here an acid. If I pour the acid into the vessel it attacks the bicarbonate of soda, and we get this carbonic acid gas liberated. I dare say we shall presently have accumulated enough for our purpose. [After an interval]—Now let me see whether the gas which has been liberated has not the power of putting out a candle. This will show whether the gas exists in this vessel or not. [A lighted taper was lowered into the vessel, and was immediately extinguished by the carbonic acid gas therein contained.] Yes: there is the gas. You see it is incompetent to support the combustion of the candle. The vessel is very nearly full. Now I will show you that this gas is very much heavier than ordinary air. I might ladle it out or dip it out in a bucket, and if I did so in front of the screen you would see it fall like water from a vessel, although under ordinary circumstances it is quite invisible. But I want to show you its heaviness by means of a soap bubble. I will blow a bubble from this clay pipe, and allow that bubble to fall upon this invisible gas. You will find that the bubble will float about upon the surface of the gas as if it were floating upon the surface of a visible liquid. [Successive soap bubbles were then produced, and on being detached from the tobacco pipe, were gently dropped on the surface of the carbonic acid gas, and, while floating there, were illuminated with electric light.]

Let me now tell you what I have sent Mr. Cottrell to do. Downstairs in the laboratory we have two very strong iron bottles, and these two bottles are filled with this carbonic acid. The gas in those bottles has been liquefied, and at the present moment he is turning a cock and allowing the liquid carbonic acid to turn into gas. What I want you to understand is that when the liquid carbonic acid turns into vapour it generates enormous cold, just as our vapour of water did on its production, only the cold generated by the carbonic acid is far greater. The consequence is, that when this liquid is turned into a gas and generates this cold, a portion of the vapour is turned into snow, and we thus obtain carbonic acid snow. I am almost afraid to speak to you about this matter, lest we should fail to get this wonderful substance. If I do get it I intend to put it into this vessel and make a few experiments with it which will both delight and surprise you. If we get the solid carbonic acid we shall be able to freeze water and produce ice in a crucible when it is actually heated to redness. First of all the carbonic acid snow is itself very cold, but in order to make it still colder I pour a little ether upon it. This turns it into a paste; and this mixture of carbonic acid and ether gives us nearly the greatest cold which has ever yet been produced. If we put that paste of carbonic acid and ether into the hot crucible, what occurs? The carbonic acid and the ether evaporate, and they so evaporate as to produce a protecting coating of vapour of carbonic acid between the red hot crucible and the pasty mass within it. In point of fact, the pasty mass does not touch the crucible at all. It remains intensely cold within the crucible. If we are successful in getting the solid carbonic acid, I shall dip this small brass sphere containing water into the mixture of ether and carbonic acid in the hot crucible; and I have no doubt that the water will freeze and will burst the brass sphere, and we shall then be able to take from the red hot crucible a sphere of solid ice. Mr. Cottrell is a long time bringing the solid carbonic acid. I am afraid he is not successful. Allow me simply to walk downstairs and see that the matter is going on rightly. [The lecturer then went in quest of the carbonic acid. On returning to the theatre he resumed as follows]—I am sorry to say that my worst anticipations have been realised. The experiment below has not succeeded. Here, however, is a little of this wonderful carbonic acid snow—solid carbonic acid. I will put a little in my mouth, and breathe against a candle. If I inhaled it I should kill myself; but I do not intend to inhale it. I intend simply to *exhale*. [The candle flame was then extinguished by the gas exhaled from the lecturer's mouth].

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 7th, 1868.

Edward Schunck, F.R.S., &c., President, in the Chair.

"*Variable Spot on the Moon's Surface*," by W. R. Birt, F.R.A.S., communicated by J. Baxendell, F.R.A.S.

The interest attaching to the phenomena presented by the lunar spot Linné is my apology for communicating a few observations on another spot which exhibits similar phenomena. It will be seen that both spots manifest phenomena which appear to be referable to the presence of a *covering* by which the craters are at times *concealed*. We are not cognisant of any agency such as libration, angle of illumination, or variation of distance which affects the forms and appearances of lunar objects, being capable of rendering a crater *invisible* while its place is occupied by a white *cloud-like* spot of light; nor are any of these agencies capable of rendering an object on the moon's surface *indistinct* while others in its immediate neighbourhood are exceedingly sharp and well defined. With the hope of directing the attention of astronomers to this curious class of lunar objects, may I be permitted to lay the following observations before the Society? They have been made principally by the Rev. W. O. Williams, of Pwllheli, who has undertaken the examination of a zone on the moon's surface of 2° of latitude, viz. from 4° to 6° south.

The spot in question is marked IV A*a* 17, IV Aζ 39 on the areas of the British Association Lunar Map IV A*a* and IV Aζ, and is situated in 2° W. long., and 5° S. lat. It is also situated on the S.W. side of the ridge forming the N.E. boundary of Hipparchus, and has been described as a bright spot S.S.W. of IV A*a* 7 (Beer and Mädler's Hipparchus F). Its diameter is 5"·94 and magnitude 0°·37, the diameter of Dionysius being regarded as unity. On De La Rue's photograph 1858, February 22, it appears as a spot of about 4° of brightness. It is not so bright as Linné, which is about 5°. In this photograph it is seen to stand upon the east edge of a large *depression* running nearly S. by W.—N. by E. This edge, which forms a low ridge, connects the mountainous boundary of Hipparchus with the mountain IV Aζ 37. IV A*a* 7, a bright spot smaller than IV A*a* 17, IV Aζ 39, stands upon the west edge of this depression, which also meets the mountain IV Aζ 37.

On Rutherford's photograph 1865, March 6, this spot appears brighter that in De La Rue's, viz. 5°. Linné in this photograph is 6°. The observations that have been made of this spot are as under—

Year.	Date.	Authority.	Character.	Brightness.
1858	Feb. 22	De La Rue, Ph.	A bright spot.	4°
1865	Mar. 6	Rutherford, Ph.	A bright spot.	5°
1867	May 11 8½.....	Birt, Obs.	A shallow crater.	
1867	Oct. 7 8½ to 10	Williams, „	A very bright spot.	
1867	„ 17	Ingall, „	A faint shallow crater.	
1867	„ 17 13½....	Ingall, „	Drawn as a crater.	
1867	„ 17 13 to 15	Williams, „	A very conspicuous crater.*	
1867	„ 18 17 to 19	Williams, „	Crater very conspicuous, with a small central cone casting a shadow.	
1867	Nov. 5 9 to 10	Williams, „	Very bright, a streak of interior shadow on the west.	7°
1867	„ 6 8 to 10	Williams, „	A bright patch of light, streak of shadow scarcely discernible.	6°
1867	„ 15 18 to 20	Williams, „	Very bright.*	10°
1867	Dec. 5 6 to 8	Williams, „	A whitish spot, no trace of a crater.	5°
1867	„ 6 9 to 10	Williams, „	A whitish spot no crater.	5°

* On these occasions Mr. Williams saw a small bright point to the E., which he considered to be the *highest* point of the ridge.

Mr. Baxendell stated that on the night of the 3rd instant he had an opportunity of examining the spot referred to by Mr. Birt with Mr. Gladstone's equatorially mounted achromatic of 7¼ inches aperture, using powers from 60 to 250. It was then a well-marked though shallow crater, having a diameter about three-fourths of that of Beer and Mädler's Hipparchus F. The shadow of the western wall was very conspicuous on the floor of the crater.

Mr. Baxendell also read the following extract of a letter dated November 27th, 1867, which he had received from Mr. C. Ragoonatha Chary, the first native assistant at the Royal Observatory, Madras:—

"I have prepared the necessary calculations connected with the total solar eclipse to take place in the Indian Peninsula on the 18th of August, 1868, and these, with appropriate description and remarks on the eclipse by N. R. Pogson, Esq., are now in the press and will be published in the leading Madras Almanac. In these calculations I find that a slide-rule constructed for trigonometrical purposes may most advantageously be used even in such intricate cases as the solar eclipse. It saves more than three-fourths of the time and labour; and having calculated independently with the slide-rule as well as by means of logarithms for several places, I found the difference rarely to amount to half a minute in time, which is no great matter in predicting for amateurs, and even for intending observers. Mr. Woolhouse's method is followed, I believe, in the Nautical Almanac. The skeleton forms of this method, which are printed in great detail for logarithmic calculations, may be greatly simplified and facilitated by the use of a slide-rule accurately divided. The one I used was not very accurately divided, and was only two feet in length.

"*On the Examination of Water for Organic Matter*," Part II., by Dr. R. Angus Smith, F.R.S.

At present the conclusion only is given, as no abstract was prepared.

The following may be considered as a summary of the results required for sanitary purposes.

1. Quality of the organic matter, *i.e.* what is produced by standing under favourable circumstances for developing vegetable or other life?

2 and 3. Condition of the organic matter. Products of decomposition. Easily decomposed organic matter. These two can be estimated for sanitary purposes sufficiently by permanganate of potash.

4. Nitrates as remnants of organic matter.

5. Nitrites as remnants of organic matter.

6. Chlorides as indicating animal sources.

7. Oxygen as indicating activity of decomposition or destruction.

8. Total organic matter and ammonia, by weighing and other methods.

PHARMACEUTICAL SOCIETY.

Wednesday Evening, February 5th, 1868.

G. W. Sandford, Esq., President, in the Chair.

The minutes of the preceding meeting were read and confirmed. The thanks of the meeting were given for several donations to the library, and the President directed attention to a fine collection of drugs from North America, which had been presented to the Society by Mr. William Procter, jun., of Philadelphia, who is an honorary member of the Society.

Professor Bentley said the collection was a very interesting one, especially as American remedies had lately been brought so prominently under our notice. The specimens would be placed in the museum for examination.

Mr. H. S. Waddington read a valuable paper on "*Micro-Sublimation*," in which he gave the results of his experiments with a number of the alkaloids, such as santonine, salicine, narceine, papaverine, cinchonine, narcotine, strychnine, iodine, &c. Some very interesting slides were on the table illustrating the results of Mr. Waddington's researches, which were examined under the microscope by the members before and after the meeting.

The President, in thanking Mr. Waddington for his excellent paper, expressed his pleasure at seeing Dr. Guy present, who had devoted so much time and attention to the subject of sublimation.

Dr. Guy said the Society was under great obligations to Mr. Waddington for his paper, and referred to the beautiful specimens which he had seen before the commencement of the meeting. He had obtained some very fine ones himself, but only after thousands of experiments. He attached the greatest importance to the subject, and believed that greater results would be obtained by pursuing it still further.

Dr. Attfield made some remarks on the subject, and said that their warmest thanks were due to Dr. Guy and Mr. Waddington, for the fresh facts they had brought before them; several bodies which were believed to be fixed, were now found to be volatile.

Professor Bentley read a paper contributed by Mr. Broughton, B.Sc., F.C.S., on a "*False Cinchona Bark of India*," at the conclusion of which

Dr. Attfield read a paper on the "*Preservation of Syrup of Iodide of Iron*," by Mr. T. B. Groves, F.C.S., who has for some time been engaged in devising means for preserving the syrup. He had found that it kept better when made with iron filings instead of pure iron in the form of wire, which he attributed to the presence of impurities in the filings. He had added dilute sulphuric, and phosphoric acids as preservative agents, and had obtained successful results with them. Mr. Groves prepared a number of specimens of the syrup, and to one he added 1 minim of dilute sulphuric acid to the oz.; to another, 2 minims of dilute phosphoric acid to the oz.; to a third 2 minims of dilute phosphoric and 1 minim of dilute sulphuric acid to the oz.; and to another specimen 8 drops of phosphoric acid. He had found that phosphoric acid was the only acid to be relied on, and it was very necessary not to add the acid before the syrup had cooled.

The President said that as Dr. Redwood had assisted in compiling the present Pharmacopœia, he would, perhaps, give them his opinion respecting the method proposed by Mr. Groves.

Dr. Redwood said that he was not at all prepared to admit there was any occasion to make the alteration; the syrup of the British Pharmacopœia would keep for any reasonable time if properly prepared.

Mr. Ince greatly disapproved of such an addition, and thought it quite unnecessary. He had for a long time, before the Pharmacopœia was issued, made it according to that form with the most satisfactory results. The Pharmacopœia form was the same as that of the French Codex, which had always given good results.

Mr. Gale had adopted the form given in the present Pharmacopœia for ten years, and he had always found it successful; the syrup would keep well for six months.

Mr. Wood, of New York, could not agree with all the remarks he had heard from Mr. Ince and Mr. Gale; he had found that if the syrup of iodide of iron was kept longer than three months, a layer was formed on the surface.

Mr. Umney had also found a layer on the surface after three months; the syrup would keep very well for that time by putting it into bottles while hot.

Dr. Attfield then explained a simple mould for suppositories which had been forwarded by Mr. Laird, of Dundee. The idea suggested itself to him when witnessing the preparation of gelatine pastilles at Keiller's marmalade manufactory.

The President said that as the hour was late, the reading of the other papers must be deferred till the next meeting, which would be held on the 4th of March.

FOREIGN SCIENCE.

Paris, Feb 4, 1868.

Ozone and the cholera.—The nature of the troïlite.—Method of distinguishing the protosulphide of iron from the magnetic sulphide.—A new material for hats.—Ulmic and humic acids.—Reaction by which phenic acid may be distinguished from creosote.—Important products extracted from the olive, and from the Australian myrtle.—Academy of Sciences.—Respiration of cattle.—Study of a disease which attacks ruminants.—Production of nitrous gas during the fermentation of beet-root juice.—Niobium and tantalum.—On dissociation.—Phenomena intimately connected with muscular contraction.

During the autumn of last year, when the cholera was felt severely in Turin, Father Denza studied the meteorological condition of the atmosphere; he studied especially the connection between the prevalence of the disease and the absence of ozone. His observations were made at Moncalieri, rather more than half a mile from the town: the electricity was measured as well as the ozone. During the days in August and September, when the cholera was at about its height, the amount of ozone present was variable, but considerable—perhaps about the average. The electricity, however, during these days almost entirely disappeared; it is an interesting observation.

M. S. Meunier has recently published some facts concerning certain compounds occuring in meteorites, pyrrhotine Fe_7S_8, and troïlite. Troïlite has been considered by several mineralogists as a protosulphide of iron; the results M. Meunier has obtained in analysing many samples of troïlite, separated from meteoric iron, lead him to believe that the composition is much nearer that of magnetic pyrites. He indicates also a method of distinguishing these two substances so nearly alike in constitution, troïlite and pyrrhotine. The reaction consists in the precipitation of copper from its solutions by the one and not by the other. A number of experiments were made with artificial protosulphide and pyrrhotine; it was found that the protosulphide precipitated a solution of copper exactly like iron itself, while the magnetic sulphide gave place to no such reduction. The proto-sulphide obtained in the dry way exhibits the reaction even better than that obtained in the wet way, since the copper is not deposited in such fine particles. By melting iron and sulphur together, sulphides containing a little more sulphur than the protosulphide are obtained. In experimenting with these compounds as soon as the proportion of sulphur approached that of the magnetic sulphide, the precipitation ceased to be possible. Certain phosphides of iron, like the protosulphide, give rise to a precipitate. We may hope for further details.

Your correspondent hears, on good authority, that an entirely new kind of hat will be introduced in the summer. It will be made of paper in imitation of straw. The process of manufacture is curious, and probably quite new. A straw hat of the required size is covered with plumbago and electrotyped, the straw is burnt out of the mould, and manilla paper pulp pressed in. The invention is said to be that of an American. Many advantages, such as being waterproof and light, are claimed for the material.

M. Lefort has separated from among other substances contained in the trunks of old trees, an acid to which he gives the name xylic acid. This acid possesses the formula $C_{24}H_{14}O_{16} + HO$; it presents itself in the form of a vitreous black hard substance. Apparently this compound is the basis of all the compounds studied up to the present time, under the names of ulmic and humic acids.

M. Rust has made known a reaction by which phenic alcohol may be distinguished from the creosote separated from beech-wood tar. A mixture of 10 parts of collodion and 15 parts of phenic acid, forms a gelatinous mass, while the creosote from beech-wood tar mixed with collodion gives a clear solution.

M. de Luca, professor of chemistry to the Faculty of Science in the University of Naples, contributed at one of the meetings of the Société d'Encouragement, a memoir on some important products extracted from the olive and from the Australian myrtle. When the leaves of the olive are kept in strong alcohol they lose water, and at several points upon their surface radiated silky needle-shaped crystals make their appearance. If the leaves are treated with boiling alcohol, the liquid on cooling deposits the same crystalline matter; in this case, however, contaminated of course with all the other principles soluble in hot alcohol. The crystals have a faint sweet taste. The substance is not very soluble in alcohol, and its point of fusion is 164° to 165° C. Its composition is expressed by the formula $C_6H_7O_6$; the physical properties resemble those of mannite extracted from manna. The principle is present in the leaves during development, in small quantity, increasing with their growth; the amount diminishes at the flowering and when the leaves begin to lose their green tint. The process of extraction is easy; the leaves are macerated in water, and the liquid evaporated. The mannite does not undergo fermentation under the conditions, and is found in the residue. The flowers of the olive contain abundance of mannite; taken in the month of June and placed in alcohol, a solution is obtained, which when the winter arrives (by the fall of 10 or 15 degrees) deposits mannite. The juice obtained from the fruit of the Australian myrtle, by simple expression, is of a fine violet red colour, its taste is slightly acid and very agreeable. This juice, which contains glucose, cream of tartar, and free tartaric acid, undergoes fermentation at the ordinary temperature with disengagement of carbonic acid and production of alcohol. The wine of the myrtle, that is to say, the fermented juice, acquires in time a particular ethereal odour, very agreeable, and which constitutes to some extent a bouquet. By a further exposure to the atmosphere, and the aid of porous bodies, vinegar is easily obtained. There are many analogies between the juice of the myrtle fruit and that of the grape. The myrtle flourishes admirably in Australia in the open air.

At the meeting on the 27th January, M. Dumas thanked the Academy for the honour it had conferred upon him in making him perpetual secretary. The President announced the loss by death of M. Serres. M. Reiset communicated three memoirs, entitled—(1.) Chemical researches on the respiration of farm cattle, and the influence of dieting. (2.) Study of the gas produced during the meteorisation of ruminants; application to veterinary therapeutics. (3.) Note on the production of nitrous gas during the progress of fermentations in distilleries. Estimation of the proportions of ammonia contained in beet-root juice. M. Marignac communicated a research upon the reduction of niobium and tantalum, M. Debray contributed a memoir on "Researches on Dissociation." M. Des Cloizeaux sent a note "on the clinorhombic form, to which harmotome and Wœhlerite ought to be referred, after the late researches on the dispersion of the value of their optic axes." M. Marey addressed a note on phenomena intimately connected with muscular contraction. M. Reiset used in making the experiments which form the subject of his first memoir, apparatus of such dimensions as to enable him to submit the exhalations of calves, full-grown sheep, &c., to examination. During the respiration of calves and sheep, he found a considerable quantity of proto-carburetted hydrogen in the gaseous mixture. This, too, is under the normal conditions. Calves in some experiments were fed upon milk only; deprived thus of vegetable food, the gaseous mixture exhaled resembled more nearly in its composition that exhaled by the carnivori. The production of carburetted hydrogen became absolutely *nil*. M. Reiset considers the formation of carburetted hydrogen in the stomachs of ruminants, when upon their natural food, to be a phenomenon of incomplete combustion. He deduces from these and former researches, the general conclusion, that the respiratory products depend much more upon the nature of the food than upon the species of the animal.

M. Reiset's second memoir referred to a disease which attacks cattle feeding on pasturage. The effects are rapid swelling, and, finally, suffocation. He analysed the gas produced, that which in fact causes the swelling. He found it to be almost wholly, 74 per cent carbonic acid. Alkalies are therefore proposed as remedial agents. The third memoir relates to beet-root juice fermentation. As the manufacture of beet-root sugar is not an English industry, an abstract of this memoir would probably possess little interest for your readers.

M. Marignac communicated to the Academy the account of a number of experiments upon the reduction of niobium and tantalum. Fluoniobate of potash is reduced by heating with sodium in a wrought iron crucible; the product is, however, nioburet of sodium, which remains as a black powder disseminated in the fused mass. Water destroys the combination, nioburet of hydrogen being produced with some disengagement of hydrogen. Nioburet of hydrogen contains about 1 per cent of hydrogen, agreeing, therefore, with the formula NbH. It is a fine black powder. having a density varying from 6 to 6·6. By roasting it is promptly converted into niobic acid, entering into ignition, though the increase in weight reaches only 37 or 38 per cent, while theory requires 41. This hydride is not attacked by hydrochloric acid; it is very stable; heated to full redness for an hour in a current of hydrogen, it only loses ·1 per cent. An attempt was made to reduce fluoniobate of potash by magnesium; a violent detonation resulted. Similar treatment with aluminium in a black-lead crucible gives place to a compound of that metal and niobium, having for its formula $NbAl_3$, which is obtained upon treating the button of aluminium with hydrochloric acid. This is a lustrous crystalline compound. It is only oxidised very incompletely by roasting. M. Marignac has obtained an analogous compound of tantalum, $TaAl_3$, by heating the fluotantalate of potash with aluminium. It is also a lustrous crystalline powder scarcely attackable by hydrochloric acid, and only oxidised slightly by roasting. The general result of his researches M. Marignac considers to be a confirmation of the analogy that has been already observed between the metals niobium, tantalum, and silicium. He thinks these three metals, with zirconium and titanium, should be grouped together. The atomicity of these metals, he remarks, is not, however, the same; niobium and tantalum are pentatomic, while the others are tetratomic.

M. Marey's memoir upon phenomena, intimately connected with muscular contraction, was purely physiological.

M. Debray states in his memoir that a hydrated salt has for each temperature a tension of dissociation which is measured by the elastic force of the aqueous vapour which it emits at this temperature. Admitting this, the phenomena of efflorescence and hydration are easily explained. A salt effloresces when the tension of its water vapour is greater than that of the aqueous vapour existing in the atmosphere. A dry salt becomes hydrated when the tension of the aqueous vapour contained in the atmosphere is greater than that which the salt emits at the same temperature. Hydrous salts which do not effloresce owe, then, this property to the fact that the tension of the aqueous vapour emitted by them at ordinary temperatures is always inferior to that commonly possessed by the atmospheric aqueous vapour; these same salts effloresce when placed in an atmosphere where the elastic force of the aqueous vapour contained in the air is less than that which they emit.

Manufacture of Sugar.—The following modification in the process of refining sugar has been invented (and patented) by L. Pierre and R. Massey. The saccharine juice after being clarified in the usual way by means of lime and carbonic acid is precipitated at boiling temperature with caustic baryta (60 parts of the latter for every 100 of sugar), the precipitate suspended in water and decomposed with carbonic acid. A pure solution of sugar is thus obtained which only requires to be evaporated.—(*Zeitschr. Rübenz, Ind. Zollv.* 1867, 85, *and Zeitschr. Chem.* N.F. iii. 667).

NOTICES OF BOOKS.

Principles of Chemistry Founded on Modern Theories. By M. Naquet, Professor Agrégé a la Faculté de Médicine de Paris. Translated from the second Edition by William Cortis, Student, Guy's Hospital. Revised by Thomas Stevenson, M.D., Demonstrator of Practical Chemistry, Guy's Hospital. London: Henry Renshaw, 356, Strand.

One of the best marked features of a truly original mind, universally denoting genius in its possessor, is the power of showing its individuality at once, and stamping with a personal authority all that is produced by it. Every one acquainted with modern scientific literature must have convinced himself by negative evidence of this truth; but the chemist, with ample materials of this kind in the ordinary run of works on chemistry, has more opportunities of estimating positively the value of originality in a text book than most scientific teachers or students. M. Naquet shows his originality, clearness of expression, and facility of explanation in his very first sentences, and by his power of blending new facts and ideas with old facts and ideas expressed in a clear and definite manner, he manages to sustain the interest of the reader from the very first words to the last. This force of language, with no disparagement to the translator (for the work is translated as well and accurately as could be), is more noticeable, of course, in the original language.

There is a style in the language of the opening sentences that reminds us of Lamartine, Guizot, or Victor Hugo—clear, precise, forcible. Interest is at once excited, and, as in a well-written tale, never flags.

"Si nous jetons les yeux sur ce qui nous environne, nous sommes frappés par la vue d'une multitude d'objets d'une diversité infinie. Tous ces objets, quels qu'ils soient, ont reçu le nom générique de corps.

"Ce qui constitue les corps s'appelle matière ou substance. D'une manière générale on peut dire, que la matière est tout ce qui frappe nos sens, et d'une manière plus scientifique, que la matière est tout ce qui obéit aux lois de la gravitation."

The original is quoted here to show the easy way in which the French language adapts itself to the expression of scientific thought; and it will be easily seen from this one specimen (space forbids more) how much grace and ease is lost in translation. A translation (we are sorry to say) was necessary, and the work could not have been more ably done than it has been by Mr. Cortis. In considering M. Naquet's book as a chemical work, and not a translation only, a clue to its character is at once given by the opening sentence just quoted. It must be classed, then, as the production of a chemical physicist, rather than that of a chemical mathematician or chemical naturalist. Matter and its properties open the chapter, and so throughout the work. To a physicist a definite law is all supreme; for him there are no exceptions, everything has definition, and must suit that definition; his teaching is absolutely material; and granting that elementary mathematics formed the basis of physics, he, nevertheless, will not allow the abstract deductions of mathematics to hold an equal value with material facts. The majority of English chemists belong to neither of the above schools, but belong rather to a naturalist class, which recognises gradation with no sudden, sharply drawn boundary line. With them a sum of characters defines a position. To illustrate by an example of what is a metal and what a non-metallic body, or, as M. Naquet calls it, a metalloid. One person will argue that hydrogen is similar to silver, and that if silver is a metal hydrogen is a metal also to all intents and purposes. The naturalist will say that from the sum of characters the extreme members of the series are undoubtedly the one or the other; but that when we reach the mean members, we may as justly say silicon as silicium, arsenicum as arsenic. M. Naquet, as a physicist with his definite rules,

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gives six characters as follows for an absolute determination:—

METALLOIDS.

I. Several metalloids are gaseous.
II. Metalloids have not the lustre called metallic.
III. Metalloids are bad conductors of heat and electricity.
IV. Metalloids have a density relatively low.
V. Oxides of metalloids, on combining with water, ordinarily produce acids, seldom bases.
VI. Metalloids are *always* electro-negative in the compounds which they form on uniting with metals.

METALS.

I. There is no gaseous metal.
II. Metals possess metallic lustre.
III. Metals are good conductors of electricity and heat.
IV. Metals have a density relatively high.
V. Oxide of metals, on combining with water, produce bases, seldom acids.
VI. Metals are *always* electric-positive in the compounds which they form on uniting with metalloids.

Thus the first and the sixth characters are given as absolute. It will be seen at once, however, that there is a very considerable element of relativeness in these absolute characters. If the gaseous state be a standard, mercury is more accurately a metalloid than carbon is; and electro-positive and electro-negative are surely relative terms, and, in a chemical classification as such, should not have undue weight. As the result of this arbitrary classification to the neglect of a sum of characters, tin, titanium, thorium, antimony, bismuth, uranium, tantalium, and niobium figure as metalloids. Carbon is not to be found in either list, we suppose from inadvertence; nevertheless, it might afford difficulties to the theoretical classifier. It surely would be better, in the face of these facts, to abolish the meaningless expressions, metals and metalloids, altogether, than do violence to our preconceived ideas with no satisfactory result.

The above is only an instance of a plan generally followed of harmonising ancient with modern ideas. Thus, in nomenclature when the old chemistry is done violence to, in accordance with modern ideas, for a given rule of four lines, we find four exceptions that require for a terse explanation as many pages of the volume. The consistency of the resulting nomenclature will at once be seen by glancing at the following list:—Mercuric nitrate, mercurous nitrate; mercuric chloride, protochloride of mercury (calomel); biniodide of mercury, protoiodide of mercury; proto-sulphide of mercury, subsulphide of mercury, mercuric sulphate, subsulphate of mercury, for the two sets of salts respectively.

We venture to say that the "safe middle course" of different systems of nomenclature will satisfy no English chemist, and that many modern English text books are in this respect decidedly superior to that of M. Naquet, both in consistency and simplicity.

But not to prolong our criticism further, we will freely accord to M. Naquet what is claimed for him by his translator—that he "explains and gives with great ability the arguments for and against his theories and those of other chemists." M. Naquet designed it for the classic text book of the French student of medicine; "the work only pretends to be a point of departure." "In our opinion students enter upon a false path when they neglect a knowledge of laws to gain *simply* an acquaintance with a number of facts, with which they uselessly overload the memory." Now, we must do the English medical student the justice to say that in very exceptional instances does he overload his memory with chemical facts; whether usefully or not we will not pretend to decide. It seems to us that the work is adapted for those who have a sound knowledge of chemistry, whether it be ancient or modern. In this case any bias will be avoided. In fine, the book before us is not solid enough for a foundation; but the thoughts suggested by every page are necessary for a completion of a chemical education. To go further, in one sense, this text book of chemistry is more than any other suited for the medical or chemical student's training; for its mastery he must use his brains and enlarge his ideas; but it should not be used too early in his career. We will add that, if the French medical student is accustomed to express himself as follows: "The coefficients representing the quantities of salts decomposed in two saline couples, containing the same radicles grouped in inverse order, are complementary;" he is infinitely superior to his ordinary British representative, who has not yet mastered the law of Volkmann, who stated that the frequency of the pulse in man, as connected with his stature, was in the ratio of the ninth root of the fifth power of the height.

This translation of M. Naquet's book has been conscientiously and accurately done. A great need felt for it among certain students will be amply satisfied; and as a further recommendation to a very well printed and got-up book, the casts of the original plates of M. Kekulé's diagrams have been used.

CORRESPONDENCE.

WATER ANALYSIS.

To the Editor of the Chemical News.

Sir,—Will you allow me to state, that after a careful consideration of the points in my report of the Chemical Society, alluded to in the letters which appeared in last week's Chemical News, I am convinced that the report was substantially accurate. With regard to the point raised by Mr. Thorp, discussion upon an error (granting such to be the case) affecting himself only, is now futile, since he has corrected what he considers to have been misinterpreted.—I am, &c.,

The Reporter.

IMPURITIES IN GLYCERIN.

To the Editor of the Chemical News.

Sir,—The writer of the article on Glycerin in *Kunst und Gewerberblatt* is correct in attributing the acrid, irritating properties of some glycerin to the mode of preparation; but I have seen distilled glycerin which was quite as unsuitable for medicinal or surgical purposes as any spoken of. The volatile fatty acids, and ethers, which exist in crude glycerin, are sometimes condensed with the glycerin, and these have very irritating properties.

In the glycerin which is made without distillation, the volatile acids, and ethers exist, but not in the same state as after distillation, the high heat required for this process decomposing them into some modification of their original state.

The great cause of irritation in glycerin which has not been properly prepared, is the presence of oxalic acid and of formic acid; these are produced by the action of sulphuric acid upon the glycerin, forming the first-mentioned acid, and this in its turn acts upon the glycerin, giving rise to formic acid, the irritating properties of which are well known.

The nitrate of silver test I have always considered the most reliable. Glycerin which shows no reaction with this salt, may be considered suitable for all uses, as it indicates not only the presence of chlorine or chlorides, but is, as well, reduced by acids which may exist in the glycerin.—I am, &c.,

Henry Bower.

Philadelphia, January 16th, 1868.

MISCELLANEOUS.

Faraday.—Several letters have recently appeared in the daily papers urging the propriety of continuing Faraday's pension to his widow. It has been thought, however, by many, and especially by those best able to judge, that our great philosopher, had he been alive, would have regarded anything of the kind with repugnance. This is borne out by the letter written by Dr. Bence Jones to the *Times* of the 30th ult. Dr. Bence Jones says that he has been requested by Mrs. Faraday to express her thanks for the interest the public are disposed to take in her behalf. The whole course of her husband's life was so marked by his love of retirement that she feels most keenly the intrusion of his name even, while she cannot but be grateful for the kindness which causes her so much pain. She wishes him to assure all those who value Mr. Faraday that the recognition that has already been made of his merits has given her more than she either requires or desired; and she is most anxious that his name should not be used in a way which he never would have approved.

Country Wells.—Dr. Attfield has written a letter to the *Times* on this subject. After alluding to the fact that wells are generally sunk where most liable to contamination, and often receive the contribution of sewers, he says that mineral matter dissolved from the soil is comparatively harmless; animal and vegetable matter may be harmless, but may be poisonous, and must, therefore, be kept out by every precaution. Good soil is here our best friend, Nature's own purifier, entirely destroying the substances last mentioned, if only allowed to have fair play; but its power for good is limited, its power for harm terrible, when saturated by drainage from adjacent accumulations of filth. Polluted water does not generally betray its condition till possessed of a strong odour; earlier intimation may, however, be obtained by the following tests:—Half fill a common water-bottle, cover its mouth with the hand, violently shake for a minute, and quickly apply the nose. If nothing unpleasant is detected, tightly cork the bottle, set it aside in a warm place at about the temperature of one's body for a couple or three days, and repeat the shaking, &c. Water of very bad quality may thus be recognised without the trouble and expense of analysis.

Famine in Eastern Prussia..—The *Berlin National Zeitung* writes as follows: The government district physician, Dr. Pinkus, of Insterburg, which town is in the centre of the country suffering from famine, appealed to the public to send among the many gifts of food above all Liebig Company's extract of meat. He says: already in several districts typhus appeared; great misery exists and greater misery must be expected. Even were money always at hand it would not be possible in many cases in distant villages and cottages to procure fresh meat for the patient, and still less good strong beef tea, the best and most indispensable of all medical comforts in such cases. Medical men in Germany who are in the habit of visiting the poor, find it very useful to carry with them a small jar of extract, so as to dispense beef tea at once where they find it necessary.

Glycerin.—The value of glycerin as a remedy for various skin affections is now generally known and admitted; it was therefore both natural and desirable that it should be presented to us in the solidified and therefore most convenient form of a soap. So numerous are the uses and purposes to which glycerin may be applied, especially in combination with other remedial substances, that glycerin compounds abound. Unfortunately, many of these so-called mixtures of glycerin are so in little more than name; they are either destitute of that substance, contain it only in minute quantities, or, when even present in larger amount, the quality is often by no means good. This observation applies with more or less force to many of the so-called glycerine soaps, perfumes, and cosmetics. In Price's solidified glycerin, however, we possess an article of really definite composition and of superior quality, and one on which we believe that the profession and the public may fully rely. It is stated of this glycerin compound that it wears well, gives a rich lather, and that it contains over half its weight of Price's distilled glycerin, the accuracy of which statement we verified by the follow per-centage analysis:—

Water	21·5
Fatty acids	29·5
Soda	3·7
Glycerin	45·3
	100·0

The Lancet.

NOTES AND QUERIES.

Waterproof Paste.—I understand that calico printers use a paste called "resist paste," which is waterproof, of the following proportions. 1lb. of binacetate of copper or distilled verdegris; 3lbs. of sulphate of copper, dissolved in one gallon of water; this solution to be thickened with 2lbs. gum senegal; 1 lb. british gum; 4lbs. pipe clay; 2oz. nitrate of copper, as a deliquescent. Can any of your readers kindly inform me if I can use it to stick lithographic bills on cards without detriment to the colours or the paper on which they are printed?—C. E.

Sprengel Air Pump.—Could any one give me about the dimensions for a Sprengel air pump, and the quantity of mercury required. I wish to use it for exhausting vacuum tubes for a 4-inch spark induction coil.—Ein Englander.

Sulphur in Pyrites.—Can any of your readers kindly inform me of the method usually adopted for ascertaining the amount of sulphur in iron or copper pyrites, to determine its value for sulphuric acid making? Is there not a practical method of assaying it?—T. W. W.

Estimation of Tannin in Gall-nuts, Sumac, &c.—Can any of your correspondents favour me with a good method for estimating the amount of tannin in either of the above, and also the percentage amount of tannin in the different qualities of sumac in the market?—Astringent.

TO CORRESPONDENTS.

Sutton.—Not yet published.

J. Horsley.—Received with thanks.

G. J. De Winton.—See below.

Astringent's letter shall be attended to.

J. T.—The odour is one of the properties of naphtha inseparable from it.

John C. Tellers.—Will our correspondent forward a few specimens with particulars as to cost of production, &c.? We shall then be enabled to form an opinion.

Swedish Portable Cooking Apparatus.—Will the maker of this apparatus please communicate address to our office?

Chemicus.—We have been quite unable to find out the name of the firm. The announcement was made on the authority of the late Dr. Richardson.

R. B. C.—A communication is waiting for you at our office. Please forward your address.

Ein Englander.—A solution of isinglass in weak spirit is the best cement with which to fasten on the sides of a hollow prism for bisulphide of carbon. Chloroform will be the best solvent for india-rubber to be used for coating a bladder. Zinc may be quickly amalgamated by dipping it into mercury containing a little sodium amalgam dissolved in it. Apply to Asher's, foreign bookseller.

H. P. M.—The piece has a similar composition to a Roman mirror, which according to an analysis by Professor Church, contained 70·29 per cent of copper, and 29·91 per cent of tin. The similarity, however, is not likely to be more than a coincidence.

Communications have been received from O. W. Parker (with enclosure); Rev. B. W. Gibsone, M.A. (with enclosure); J. Cliff; E. Dring (with enclosure); Professor Tyndall, F.R.S.; W. Scott; E. Hopwood (with enclosure); The Abbé F. Moigno; F. Montgomery; H. Octavius; J. Horsley (with enclosure); W. Valentin; G. J. De Winton; Mr. Sutton; R. Googan; W. Ackland (with enclosure); W. Isbister (with enclosure); J. Emerson; H. Hodgkinson; W. Richardson; J. Murray (with enclosure; T. Cobley; Alfred Payne; W. Miller and Sons (with enclosure); W. G. Drysdale (with enclosure); Rev. E. Smith, M.A.; G. A. Keyworth; Dr. Aloin Pflughaupt; R. McAlley; Rev. M. Kiernan; J. Wilkinson and Co.; W. Smith;. F. Sutton; Dr. R. Angus Smith, F.R.S.; Mottershead and Co.; W. Poole Balfern; Rev. R. Kirwan; D. Shaw and Sons; Nicholson, Maule, and Co.; G. W. Eccles; T. W. Tobin (with enclosure); J. E. Thorpe (with enclosure); Rear Admiral Sir F. Nicolson; O. Grimet; Dr. Adriani (with enclosure).

Books received.—"El Correo Hispano-Americano;" "On the Magnetic Attraction of Cosmical Bodies," by John A. R. Newlands, F.C.S.; "Scientific American;" "American Artisan;" "Pharmaceutical Journal;" "Hardwicke's Science Gossip;" "Journal of Gas Lighting."

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Monatsbericht der Königlich Preussischen Akademie der Wissenschaften zu Berlin.
July, 1867.

G. Rose, "On the Preparation of Crystallized Bodies before the Blowpipe." "On the Behaviour of Titanic Acid towards Borax, and on the Preparation of Rutile and Amorphous Titanic Acid. "On the Behaviour of Oxides of Iron towards Borax, and on the Preparation of Crystallised Hæmatite and Magnetic Iron Ore. "On the Behaviour of Titaniferous Iron Ore towards Borax, and on the Preparation of Crystallised Titaniferous Iron Ore, and Titaniferous Magnetic Oxide of Iron. "On the Preparation of Rutile by Fusing Titanic Acid and Titaniferous Iron Ore with Phosphate of Soda and Ammonia." A. Oppenheim, "New Researches on the Isomerism of Chloride of Allyl and Chlorinated Propylene."

Poggendorff's *Annalen.*
October, 1867.

A. Wangerin, "On the Theory of Newton's Rings." W. Weyl, "On Tetramercurammonium and its Compounds."

No. 9. October.

R. Ruhlmann, "Researches on the Effect of Temperature on the Velocity of Light in Water." J. C. Poggendorff, "On the Development of Heat in the Path of the Electric Spark."

Annales des Sciences Naturelles (Zoologie).
Nos. 5-6. May-June, 1867.

Rabuteau, "Experiments on the Physiological Action of Fluorides and of Metallic Compounds in general. (Review).

Annales de Chimie et de Physique.
September, 1867.

Berthelot, "On the Formation of Pyrogenous Bodies." "On the Reciprocal Action of Hydrocarbons." "Synthesis of Styrolene, Naphthalene, and Anthracene." "On the Polymers of Acetylene, and on the Synthesis of Benzine." "On the Theory of Polymers, and on the Aromatic Series." "On the Formation of Pyrogenous Bodies—Continuation." "On the Synthesis of Toluene, and on the different Principles contained in Coal Tar." On the same subject. "On some Thermo-chemical Conditions which determine the mutual Action of Hydrocarbons." V. de Luynes and G. Esperandieu, "On the Preparation and Properties of Pyrogallic Acid." Berthelot, "On the Formation of Pyrogenous Bodies—Continuation. "On the Action of Heat on the Homologues of Benzine."

October.

Berthelot, "On the Formation of Pyrogenous Bodies—Continuation: On the Action of Heat on Retene." "On the simultaneous Formation of Homologous Bodies in Pyrogenous Reactions." "On the Oxidising Properties of the Homologues of Benzene." "On the Action of Potassium on Hydrocarbons." "On the Isomeric Conditions of Styrolene." "On the Characteristics of Benzene and Styrolene as compared with those of other Hydrocarbons." "On the Combinations of Picric Acid with Hydrocarbons, and on their Use in Analysis." "On the Melting Point of Waxy and Resinous Bodies." "On the different Carbides of Hydrogen contained in Coal Tar." A. de la Rive, "On a Photometer for Measuring the Brightness of Distant Objects, and on the increased Transparency of the Atmosphere due to the Presence of Moisture." Vaillant, "On the Transparency of the Atmosphere and its Signification."

Dingler's *Polytechnisches Journal.*
October, 1867.

T. Gerlach, "On the Specific Gravity of Aqueous Solutions of Crystallised Acetate of Lead." H. Swarz, "A Method of Separating Magnesia from Lime." "On the Manufacture of Carbonic Acid and Magnesia from Magnesite." "On the Detection of Metallic Copper in Aventurine Glass." "On a Process for Smelting Tellurium Ores." "On some Points in the Preparation of Chromic Acid by Acting on Bichromate of Potash by Sulphuric Acid." M. Rosler, "On the Manufacture of Salts of Tin." L. Walkhoff, "On Dubrunfaut's Process for Freeing Molasses from Salts by Dialysis."

October.

G. T. Gerlach, "On Crystallized Chloride of Tin." H. Vohl, "On Naphthalin and its Applications." A. Ott, "A Method of Testing Commercial Phenic Acid." W. A. Herb, "On the Estimation of Vinegar, with special reference to an improved Apparatus for using Fleck's Volumetric Method."

MEETINGS FOR THE WEEK.

Monday.—Royal Geographical, 8½.
—— Medical, 8.
Tuesday.—Royal Institution, 3. Professor Tyndall, "On the Discoveries of Faraday."
—— Photographic, 8.
Wednesday.—Society of Arts, 8.
—— Microscopical, 8.
Thursday.—Royal Institution 3. Professor Tyndall, "On the Discoveries of Faraday."
—— Royal, 8½.
Friday.—Royal Institution, 8. Professor Roscoe, "On Vanadium and its compounds."
—— Astronomical, 8.
Saturday.—Royal Institution, 3. Professor Roscoe, "On the Non Metallic Elements."

Paris Exhibition Two Gold Medals.

Liebig's Company's Extract of Meat, as distinguished from "Liebig's Extract of Meat," which name is daily more used for all sorts of extracts. Warranted genuine and of perfect flavour by Baron Liebig, whose signature is on every genuine jar. Cheapest and purest stock for Soups, Entrees and Sauces, highly strengthening for Children and Invalids. 1 lb. 14s, ½-lb. 7s 6d, ¼-lb. 4s, 2-oz. 2s, equivalent to 1d. half-a-pint of best beef-tea. Retail, of all Italian Warehousemen, Chemists and Grocers. Wholesale, of Crosse and Blackwell; E. Lazenby and Sons; John Burgess and Son; Barron, Harveys, and Co.; Barclay and Sons; Burgoyne, Burbidges, and Squire; Wm. Edwards; M. E. Foster; Langtons, Scott, and Edden; S. Maw and Son; G. S. Pedler; T. and H. Smith and Co., London; Duncan, Flockhart, and Co.; John Mackay; H. C. Baildon, Edinburgh; Southall, Son, and Dymond, Birmingham; Wm. Smeeton, Leeds; Raimes and Co., and B. Westworth, Liverpool; Mottershead and Co., Manchester; W. Proctor and Son, Newcastle-upon-Tyne; all Wholesale Houses, and of Liebig's Extract of Meat Company (Limited), 43, Mark Lane, E.C.

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THE CHEMICAL NEWS.

Vol. XVII. No. 428.

NOTE ON THE
DETECTION OF GASEOUS IMPURITIES IN OIL OF VITRIOL.
By ROBERT WARINGTON.

It is essential for some purposes that oil of vitriol should contain neither sulphurous acid nor any of the lower oxides of nitrogen; both of these impurities are met with in some commercial samples of oil of vitriol. After trying several methods for the detection of sulphurous acid when present in very small quantity, I at last resorted to the following plan, which also admits of testing at the same time for the presence of the nitric oxides.

About two pounds of the oil of vitriol are placed in a bottle, which the liquid half fills; the bottle is then stoppered, and violently shaken for a minute or two. The gases contained in the oil of vitriol are thus washed out by the atmospheric air contained in the bottle. Sulphurous acid is then tested for by introducing into the air space of the bottle a slip of paper coloured blue by iodine and starch; the paper is conveniently held in the bottle by means of a wire and a cork. The bleaching of the paper gives evidence of the presence of sulphurous acid.

The test-paper is best prepared from Swedish filter paper; this is first passed through a well made solution of starch, and then dried. A slip of this paper is next placed in a weak aqueous solution of iodine, where it remains till it has acquired a distinct blue colour. It is then removed, pressed between blotting-paper, and is now ready for use.

The paper thus prepared gradually loses its colour by exposure to air, it should therefore be used as soon as made: for the same reason its exposure to the gas in the bottle should not exceed two or three minutes; no perceptible change of colour will occur in this time if no sulphurous acid be present. The colour of the paper is also at once destroyed by heat, it cannot therefore be used for testing the gases given off by hot liquids.

The nitric oxides are detected by substituting for the first test-paper one imbued with iodide of potassium and starch. As NO forms NO_2 on contact with air, and N_2O_3 produces the same compound on contact with air and moisture, the presence of either of these three oxides will suffice to liberate iodine on the moist test-paper, and colour the starch. Since sulphurous acid destroys the blue iodide of starch, the presence of an excess of this gas will prevent the detection of the nitric oxides. The nitric oxides are, on the other hand, without effect on the test-paper employed for the sulphurous acid. If therefore the sulphurous acid is not in excess, it is quite possible to obtain the reactions of both gases from the same sample of oil of vitriol, and this is no uncommon occurrence with oil of vitriol which has been imperfectly boiled.

After employing for some time the method above described for detecting sulphurous acid, I made experiments with the reaction adopted by the chemists who lately examined the atmosphere of the Metropolitan Railway tunnels.* They employed a test-paper containing iodic acid and starch, on which sulphurous acid *produces* a blue colour by the reduction of the iodic acid. This test they mention as capable of detecting in air the presence of 1-100,000th part of sulphurous acid; a smaller quantity than this was perceptible by its smell, but had no effect upon the paper. On examining by this test several samples of oil of vitriol, I found that I could obtain no reaction; although the same samples, when treated as above described, had distinctly bleached the blue paper previously employed. On proceeding to other samples, in which the smell of sulphurous acid was quite perceptible, the iodic-acid-paper gave a distinct reaction. Thus the blue iodine paper was bleached when sulphurous acid could not be recognised by its smell;† the iodic acid produced a reaction only when the odour of sulphurous acid was distinct. The following equations, representing the reactions of these two tests, will throw some further light on their relative delicacy—

$$SO_2 + I_2 + 2(H_2O) = H_2SO_4 + 2(HI)$$
$$5(SO_2) + 2(HIO_3) + 4(H_2O) = 5(H_2SO_4) + I_2$$

From these equations it appears that to deoxidise iodic acid so as to liberate a molecule of iodine, requires the presence of five times as much sulphurous acid as is needed for the conversion of a molecule of iodine into hydriodic acid; or, in other words, the bleaching of the blue iodine paper will be effected by 1-5th the quantity of sulphurous acid required to produce a reaction with iodic acid. The first test is thus apparently five times more delicate than the second.

In using either of the reactions here described for the purposes of general testing, it is to be remembered that sulphuretted hydrogen produces with each the same effect as sulphurous acid.

THE MICROSCOPE IN GEOLOGY.
By DAVID FORBES, F.R.S.

(Continued from page 65.)

II. Secondary or Sedimentary Rocks.

The rocks pertaining to this class are all, directly or indirectly, formed from the breaking up, or débris, of previously existing rocks. When found in the normal state of sedimentary deposition, they may be conveniently subdivided into:—

1. Rocks formed of the immediate products of the breaking-up of eruptive rocks.
2. Rocks built up of the more or less rounded or angular débris of previously existing sedimentary or eruptive rocks.
3. Rocks composed of mineral substances extracted from aqueous solution by crystallisation, precipitation, or the action of organic life.

1. *Rocks composed of the immediate products of the breaking up of eruptive rocks.*—The little attention paid by geologists in general to the study of rocks of this class, has introduced the elements of confusion into many of their inquiries, and frequently has led to very erroneous opinions being formed as to the nature and origin of certain rocks, which could never have been entertained had microscopic investigation gone hand in hand with field observation.

Rocks of this class may either be of subærial or subaqueous origin; in the former case, for example, volcanic ashes may have been deposited as beds on the surface of the land, and afterwards been covered by lava streams poured out over them; or, from having been depressed below the sea level, may have had sedimentary beds of aqueous origin subsequently superposed on them.

When of subaqueous origin, as is by far the most common case, subærial or subaqueous outbursts may force into the sea eruptive rocks, which, being at once broken up into a state of division, more or less fine, in proportion to the greater or lesser cooling power of the water mass in immediate contact, may be spread out into beds by the action of the waves; the texture of these rocks may vary from that of the coarsest breccia down to the finest mud, and, as is usually the case, such deposits may present themselves as alternating beds of coarse and fine character. Upon the consolidation of such formations, rocks are formed, identical in chemical and mineralogical composition with the original eruptive rock from which they were derived, and which, particularly when close-grained, often present an external appearance so like the original rocks as to be frequently undistinguishable from them by the naked eye; in such deposits it is often easy to pick out specimens having all gradations in appearance from the above described down to such as would be attributed to the consolidation of mere detrital mud.

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* Chemical News, November 8, 1867, p. 239.

† The purest oil of vitriol I have met with, gives some slight odour to the air with which it is shaken; but this odour is not recognisable as sulphurous acid.

No wonder, therefore, if the field geologist finds himself bewildered under such circumstances, and inclined to settle down in the comfortable belief of the transmutation or transition of sedimentary rocks into eruptive, &c., and even the chemist feels puzzled, when he finds that a rock taken out of apparently normal stratified deposits has the same chemical composition with one of undoubtedly intrusive nature. The microscopic examination, however, soon shows that, however similar the external appearance of two such rocks might be, their internal structure is totally different; showing in the primary rock the crystallised structure and arrangement previously described, whilst the secondary rock is resolved into a mere agglomeration of more or less broken fragments of the same minerals constituting the former. In beds formed from the consolidation of volcanic ashes, the microscopic examination occasionally affords evidence as to whether such ashes had been deposited on land or had fallen into water.

2. *Rocks built up of the more or less rounded or angular débris of previously existing sedimentary or eruptive rocks.*—Where sufficiently coarse-grained, these rocks constitute ordinary conglomerates, breccias, grits, sandstones, &c., and are easily analysed by the eye; but if fine, as shales, slates, &c., the microscope must be appealed to, in order to resolve them into their constituent mineral or rock particles, and by this means it will be seen that even the most compact and homogeneous specimens are a mere aggregate of more or less rounded and water-worn grains of quartz, weathered felspar, mica, chlorite, soft and hard clays, clay slate, oxide of iron, iron pyrites, carbonate of lime, fragments of fossil organisms, &c., arranged without any trace of decided structure or crystallisation, even when the highest powers of the miscroscope are employed in their examination. The physical structure and optical properties of the mineral components enable them, however, to be recognised with great certainty, even when in grains of less than 1-1000th of an inch in diameter.

3. *Rocks composed of mineral substances extracted from aqueous solution by crystallisation, precipitation, or the action of organic life.*—Under this class are included most beds of gypsum, rock salt, and other saline bodies, as well as travertine, siliceous sinter, flint, infusorial slates and earths, limestones, &c., many of which have been as yet but very superficially examined.

In the microscopic investigation of such rocks as owe their origin to the development of organic life, very considerable progress has been made, with corresponding important and interesting results.

As early as 1836, Ehrenberg proved that large rock masses were built up of the carapaces of minute siliceous infusoriæ; and, more lately, Sorby has done good service by his investigation of limestones; these he has proved not to have originally possessed any crystalline structure whatsoever, but to have been deposited as mere mechanical aggregates (aptly termed by him, organic sands or clays) formed of the débris of calcareous organisms, which admit frequently, not only of being recognised, but of having their relative proportions determined. The comparison of the microscopic structure of the organisms in chalk, with those now forming in the depths of the Northern Atlantic Ocean, indicates that there is an immense deposit now in course of formation, quite analogous to what had previously taken place in the seas of the cretaceous period; and the same able observer has shown that the reason why certain calcareous organisms are found so well preserved, whilst others had disappeared or become entirely disintegrated, was from the carbonate of lime in the first being in the form of the stable calcite, whilst in the latter it was present as instable Arragonite.

When a calcareous rock has undergone cleavage, the microscope shows a distortion of its particles and organisms, just as in a cleaved slate, though in much less degree; the measurement of such distortion serves as a basis for estimating the amount of compression undergone.

With the exception of having briefly referred to the alterations in igneous rocks, subsequent to their solidification, and the cleavage of sedimentary beds, all the classes of rocks treated of have been considered in their normal or unaltered condition; it remains now to direct attention to the use of the microscope in the study of subsequent alteration or metamorphism of rocks.

Many sedimentary beds become more or less indurated, at points where they are cut through by eruptive dykes; thus the coal-shales and clays of Staffordshire are found altered into a hard rock with conchoidal fracture, or even into porcellanite, when in immediate contact with basaltic dykes. An examination shows no change in mineral or chemical composition beyond the expulsion of the water always contained in such beds, and sections of such rocks are often seen to be quite identical in structure with those of common stoneware made from the same clays, the only difference being that the latter is usually more porous from not having been submitted to the pressure which rocks baked *in situ* would experience.

The alteration of rocks produced by infiltration may or may not be accompanied by chemical changes; thus a section of calcareous grit often shows that the calcite filling up the interstices between the grains of sand has been merely deposited from a solution of carbonate of lime which has percolated through it, and in otherwise unaltered limestones it is common to find microsopic veins of calcspar, due to minute cracks or fissures, filled up in a similar manner. Frequently, however, such infiltration is accompanied by an entire change in the chemical composition of the rock itself; thus the beds of Cleveland ironstone have been proved by Sorby's microscopical researches to have been originally shell limestones converted into carbonate of iron by the action of ferruginous solutions, the fragments of the original shells being still distinguishable in all stages of conversion; in the same manner he has proved the magnesian limestones of the Carboniferous and Devonian ages, as well as the Permian dolomites, to have been originally common limestones, or aggregations of organic débris, the particles of which, by the use of the microscope, can be traced back to their original unaltered state, from which they have been changed by the action of magnesian solutions.

The metamorphism of rocks produced by gasolytic action, as, for example, carbonate into sulphate of lime, &c., has, as yet, not been made the subject of microscopical enquiry.

The foliated schists, quartzites, &c., form by themselves a disinct and well-defined class of metamorphic rocks, characterised by structural peculiarities differing from all previously treated of.

This appears to be due to their crystalline development having originated in a solid body, and not from liquefaction; the minerals composing them differ greatly in structure from the same minerals when found in eruptive rocks. Instead of, as in the latter case, presenting themselves in more or less defined crystals, occurring in all positions and at all angles to one another, in the foliated rocks they are developed only in one general direction, not characterised by well-defined bounding planes, but forming a string of drawn-out and irregularly bounded crystalline aggregations.

The microscopic examination of these rocks proves their original sedimentary origin, often showing the contours of the originals and grains, and, as Sorby has pointed out, the existence of ripple-drift and wave structure, peculiar to sedimentary rocks alone. These rocks appear to have been micaceous and argillaceous sandstones, the constituents of which have been recrystallised *in situ*, owing to molecular action developed in the solid rock.

The quartz of these schists frequently contains numerous fluid cavities, indicating that they have been exposed to a pressure under which the water, always present in more or less quantity in sedimentary rocks, has been entangled and retained during the recrystallisation of the quartz.

The direction of the lines of foliation or crystalline development is that of the lines of least resistance in the rock, which commonly will be the lines of stratification, but in cleaved rocks will doubtless be those of cleavage. Sorby has alluded to this fact by the names of "stratification foliation" and "cleavage foliation."

In conclusion, the author hopes that it may be the means of attracting attention to the subject, and thereby of causing a hitherto almost unexplored field of microscopic enquiry to be more cultivated; and leaves it to his readers to form a correct estimate of the justness of the sneering assertion that "mountains should not be looked at through microscopes."

ON

HEAT AND COLD;

A COURSE OF

SIX LECTURES*

(Adapted to a Juvenile auditory),

DELIVERED AT

THE ROYAL INSTITUTION OF GREAT BRITAIN,

(*CHRISTMAS*, 1867–8),

BY

JOHN TYNDALL, Esq., LL.D., F.R.S.

Lecture V.

Radiant heat.—Reflection and absorption of radiant heat.

You know that towards the end of the last lecture I failed in the experiment of freezing water in a red hot crucible by means of carbonic acid snow. As I do not like failures in experiments I will try to make that good. I have here some of this beautiful carbonic acid snow, which I will now put in this red hot crucible. I will pour upon that a quantity of ether, and then I bring down into the middle of the mixture this hollow brass ball containing water. The ether is now boiling. I will put in some more of this carbonic acid snow. It burns my hand,—it is so enormously cold. This ball is very cold, and I have no doubt that already we have produced ice in it. The quantities of the substances are much smaller than I have been accustomed to work with, but I dare say we shall succeed notwithstanding all our difficulties. [After a short interval the water was found to be frozen.] There: look at that. The water in this spheroid is converted into ice, even in this red hot crucible!

I have here some mercury, and I will pour some of it into this basin. I dare say we shall be able to solidify this mercury by means of this beautiful carbonic acid snow. Now observe here what I think you have never seen before. You know the liquid metal mercury. You have it here made solid—frozen by the cold acid. This requires a far greater cold than will freeze water. I might beat this substance upon an anvil or cut it with a knife. It becomes liquid again in a moment. If I hold this solid frozen mercury in a vessel of water, the mercury will become liquid and fall, and each little drop of mercury which falls will produce a stalactite of ice. See, the frozen mercury is being melted by that water. This is really cold water, but it is hot to the frozen mercury, and a mass of ice is produced round about the mercury which has been cold enough to do that.

The best of men and the best of boys in the world, fall and fail; but when one falls the great question with him should be, "How long am I to remain down?." Every boy falls, but if he falls and fails, he ought to be up again and at it, doing his duty. And so, as we failed at the end of the last lecture in this experiment, five minutes had not elapsed before my assistant was down in the laboratory working the pump, determined to make good our failure, which we have here done.

We have now to pass on to another and very different portion of our subject. I have endeavoured to give you a kind of image, more or less perfect, of this thing that we call heat. I have endeavoured to give you a picture, as it were, which your minds should realise.

If you take a hot body and place it in the air, you find that it gradually cools. If it be red hot the glow first of all sinks, and by and by you see nothing of it. The thing gets cooler and cooler, and at the end becomes as cool as the surrounding air. Now, this heat, in the first instance, was a motion of the particles of the hot body. When the body cools it is simply giving up its motion. Now, to what does it give up this motion when you place it in the air? Well, you might say, to the air. True: and when I held the heated piece of iron in front of the screen you saw the hot particles of air streaming up into the air above; so no doubt the motion which the hot body gives up is given up to the air. But if you put the hot body in the middle of a place where air did not exist it would still cool. Now, I want you to exercise your imagination as to the manner in which this motion is disposed of, lost, or given out, when a body cools. I believe most of you understand how it is that sound travels through the air,—at least, how it is that the sound of my voice propagates itself through the air and makes every word I say audible, I trust, to you all. I have often looked into persons' throats when they were speaking, and observed cords or tendons there which are thrown into a state of vibration when we speak or sing. They cause the air to shiver, and those tremors are propagated through it, just as motion is propagated by ripples over the surface of water when a stone is thrown into it. So if I draw this violin bow across a tuning-fork, you have this beautiful sound produced. I can actually see the fork vibrating, being thus near it, and you can hear it tapping against this card. The whole function of a tuning-fork is to throw the air into tremors, and these tremors, communicated to the air, are the cause of sound. The tuning-fork communicates its motion to the mass of air which surrounds it. The vibrations of this tuning-fork gradually become less intense, and the sound which it makes gets lower. Now, that is exactly analogous to the cooling of a hot body. It communicates its motion to what is called the "ether," by means of which bodies which are hot communicate their motion to the universe around. You all hear my voice. The human ear is one of the most wonderful organs in the universe. I often think that the human ear is still more wonderful than the human eye. It is by virtue of this wonderful organ that you hear with perfect distinctness every word I am uttering: but it does not tell that this communication of motion is going on. I want to show you something that will. Instead of the ear, I will take a flame, which I dare say will give me a very good result. Perhaps one of the boys will chirrup to that flame. Every vibration produced by the lips by the act of chirruping is communicated to that flame, and makes it dance in that peculiar way. The action of this flame is an illustration of the motion produced in the air by sound. This action of flames was discovered by Professor Leconte, in the United States; and it has been worked at in this country by Mr. Barret and myself. Something passes through the air and knocks the flame down when you chirrup. The vibrations communicated to the air make the flame behave in this peculiar way.

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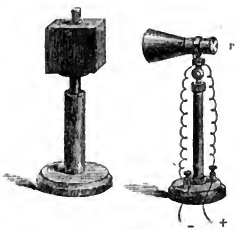
* Reported verbatim, by permission of the Author, for this Journal.

We now come to consider the cooling of a body. I say that the act of cooling must be figured in a similar way to the action of a body producing sound. The cooling body is communicating its motion, not to the air, but to this wonderful thing called the ether. The radiation passing through the air might be called the radiation of sound; but when motion is communicated to this wonderful ether it is called the radiation of heat. To illustrate this we must employ this beautiful instrument with which you are already acquainted—the thermo-electric pile. I shall now unite the ends of these wires with the pile, and we shall observe by means of our magnetic needle whether the pile is heated or chilled. I wish I could have a warm cheek here, for every one of you herepresent is a radiating body, not luminous but radiating. [The lecturer then selected a boy from the audience, and led him to the lecture table.] I want to make my young friend here my radiating body. I will first chill the pile by turning it to the cool side of the room, and then bring the needle to rest by means of this magnet. The pile itself is now a radiating body, and hence you see the needle coming down. I will now try and extract heat from the cheek of my excellent friend here. He does not touch the pile. I will depend purely on the radiation of heat from his cheek, and I will venture to say that if his cheek is not chilled by the very cold weather, the needle will move up through an arc of 90 degrees. Observe, now, the needle goes up in virtue of the heat extracted from his cheek. We will now direct the face of the pile against this comparatively polar region of the room, and allow it to waste its heat once more. Now the heat which has produced this effect on the pile is the radiant heat which I want to examine during the rest of the lecture.

I want to show you that various bodies possess the power of emitting this radiant heat in very different degrees. My friend's cheek was an admirable radiator of heat. There are various other bodies, however, much less admirable as radiators. To show this fact, I will take this cube. (Fig. 1). It is covered on three sides with velvet. One side has white velvet, one has scarlet velvet, and the other has black velvet, and this fourth side is a naked face of metal. I should like to make clear to you that these four sides of this cube possess the power of radiating heat in very different degrees; and for the purpose of showing you this I will fill the cube with boiling water. The sides of the cube will become equally heated by the hot water poured into the cube, and then I will allow them in succession to radiate against our thermo-electric pile. I dare say you will then see the distinction. I first bring the needle to zero by turning the face of the pile away from the audience; and now I place the cube of hot water on this little stand near the pile. I think you will agree with me that the outside of the metal side of the cube must be hotter than the velvet surfaces. You could feel this difference by placing your hand upon them. But still, I think the velvet will be able to produce a greater effect upon the pile than the metal surface. The metal side, you see, does not produce much effect upon the pile. Now I turn the velvet to the face of the pile, and you see that the needle goes up beyond the position it occupied when the metal side was there. I now turn the metal side back again, and the needle will go down. Now you see it going down; and when it has gone down a little more, I will turn the black velvet surface towards it, and you will see that the needle will go up again. Thus you see that the heat radiating from this velvet surface is much greater than the heat radiating from the metal; and we have from this fact a beautiful consequence which many boys would not think would occur. The consequence is this. If we filled with boiling water these two vessels, one of which is covered with a thick coating of flannel, and the other of which has naked sides of metal, and allowed them to rest here until the end of the lecture, and then put a thermometer in each to find out the temperature of the water, which vessel do you think would contain the coolest water?

Fig. 1.



Boys of the Audience: The metal one.

The Lecturer: You have not philosophised correctly upon the experiment I made with the cube. Your conclusion is the most natural one, but you saw that the quantity of heat sent away from the covered surface of the cube was greater than the quantity sent away from the uncovered surface. In the same way the quantity of heat from the radiating vessel coated with flannel would be greater than that radiating from the uncovered metal vessel, and therefore at the end of the lecture the water in the covered vessel would be three or four degrees cooler than the water in the other. In order that this difference should exist in favour of the covered vessel, it must be covered very closely; that is to say, the heat must communicate itself very freely from the surface of the metal to the flannel covering. If it were not covered closely the result would be different, and the heat would be preserved. This is the reason why ladies who wish to keep their tea-pots warm, put over them a kind of night-cap, which they call a "cozey." This cozey must, however, be loose about the tea-pot. If it were to fit very closely it would do more harm than good. However, if it does not fit tightly the heat radiates against the cozey, and the cozey prevents it from being radiated into space.

I have said that we find very great differences among substances in their power of radiating heat. Some are good radiators: some are bad radiators. The metals are all bad radiators. I now want to make plain to you another fact which goes hand in hand with this radiation. I think you will understand the experiment by which I want to illustrate this point. Here you see I have a metal surface which is a bad radiator. If that metal surface formed the side of a vessel containing hot water, it would radiate far less heat away than this surface which is coated with lamp-black. A vessel coated as this surface is would cool the hot water in it far more rapidly than a vessel composed of naked tin. Now, observe that bodies have also different powers of absorbing or drinking in radiant heat, and as a universal rule the body that is a good radiator is a good absorber. Both actions are perfectly reciprocal the one to the other. I want to make this evident to you by means of a device; for in working in physical science we have incessantly to address questions, as it were, to nature, and we do that by means of experimental devices. And now I am going, in your presence, to ask nature the question which of these two surfaces, M N or O P (Fig. 2), absorbs and takes up the heat most speedily, most rapidly, and most effectually, if both be presented to a hot body,—which of them, in fact, is the best absorber. The device that I want to employ in this experiment will be evident to you after a little attention on your part. Nothing is learned or nothing is understood without an act of attention on the part of the student; and if you do not think of these lectures afterwards, and read about the subject afterwards—if you do not dwell upon what we say here, and work at the subject, and reflect upon it—these lectures will pass away from your memories, and make very little impression. In fact, these lectures are very little good except for the purpose of stirring you up, and giving you, as it were, the first taste of science. I really do not care much about lectures. I would rather have ten or a dozen boys working away with me in a room than be preaching to them as I am doing now. However, there is good to be done in this way if you will only think about the subject, and bring your own minds to bear upon it afterwards.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 6th, 1868.

Dr. Warren de la Rue, F.R.S., &c., President, in the Chair.

The minutes of the previous meeting were read and confirmed, and the donations to the library announced. The candidates for admission into the Society were B. H. Paul, Ph.D., 8, Gray's Inn Square; Edward Dowson, M.D., 117, Park Street, London; Thomas William White, Ifield, near Crawley, Sussex; and for the second time was read the name of Mr. Martin Murphy, Royal College of Chemistry, Liverpool.

Mr. Reinhold Richter, of the Rothamsted Laboratory, was proposed by the Council to become an Associate. The following gentlemen were balloted for, and duly elected Fellows of the Society, viz.: John Wallace Hozier, B.A., Oxon, Lieutenant 2nd Dragoon Guards, Staff College, Farnborough; Herbert McLeod, Assistant Chemist in the Royal School of Mines, 61, Bridge Street, Southwark; Robert Schenk, 10, Hanover Place, Kennington; and Thomas Charlesworth, Leicester.

The adjourned discussion upon Dr. Frankland's new method of "*Water Analysis*" was resumed, and occupied the first hour of this evening's proceedings. From the press of other business—Dr. Russell's lecture, and two papers to be read—the discussion of this important subject was unduly curtailed.

Professor J. A. Wanklyn commenced by replying to Mr. Dugald Campbell, and controverting the accuracy of his statement relative to the evolution of ammonia when albumen was boiled with carbonate of soda. With respect to Mr. Abel's objection, the speaker stated that the peculiar feature of his proposed method of distillation with an alkaline permanganate, was that under its influence the organic nitrogenous matters present in the water were measured by the amount of "albuminoid ammonia" formed, and so long as the ratio remains constant and known, it matters not what is that proportion. Dr. Frankland's statement of the amount of organic nitrogen present in a water was unsatisfactory; he did not say in what form it occurred whether, for instance, as uric acid or kreatine. In some of the waters lately reported upon, it might, on the other hand, be said that nitrogenous matters occurred in quantities equivalent to 23 milligrammes of albumen. Granting that Dr. Frankland could tell the amount of organic nitrogen existing in any given sample of water, what more could he tell? The nitrogen was probably distributed in various forms of organic combination, and some of these might be more hurtful than others, but the speaker had examined a great number of such compounds, and none failed to give "albuminoid ammonia" upon distillation, and he therefore claimed the credit of suggesting that a new fundamental datum should be employed. Mr. Phillip Holland had since proposed, in the Chemical News, the adoption of a new mode of stating the results, according to which the amount of organic impurity in a water would be represented in degrees. There was also the testimony of Professor Way to the effect that "these ammonia values are a sure index of the quality of a water." The speaker characterised the new method of analysis as unsound, requiring a great length of time for its performance, and a high degree of manipulative skill; a litre of water took five days to evaporate in *vacuo*, or ten hours over a water-bath, and then the examination of the residue gave an inaccurate estimate of the amount of organic nitrogen originally present in the water, whereas the method he and Mr. Chapman described was applicable to the water itself and could be carried out in an hour and a half.

Mr. E. T. Chapman considered that the adoption of Dr. Frankland's new process of analysis depended upon the establishment of the following propositions—

1. That nitrates and nitrites are completely decomposed by sulphurous acid.
2. That none of the organic matter suffers decomposition.
3. That the ammonia is perfectly retained.
4. The determination of organic carbon demands its non-volatility in contact with sulphurous acid and sulphites.

In examining these points *seriatim* the speaker found that the decomposition of the nitrates was incomplete or uncertain; for on subjecting the fixed residue of the water to the subsequent action of aluminium and pure hydrate of soda (obtained from sodium), there was ammonia formed in small quantity from that portion of the nitrate which escaped previous destruction. Results obtained in the examination of the pump waters of Portland Street and Bartholomew Lane were quoted, as also an artificial sample of South Essex water. In all these cases some ammonia was indicated by the Nessler test; but inasmuch as the alkaline sulphites interfered, a preliminary distillation with caustic alkali was always resorted to. From Mr. Wanklyn's experiments it appears that the ammonia is not perfectly retained during the preliminary evaporation of the water, but that a loss even of one-third may be experienced. Notwithstanding this loss, however, the discrepancy between their own and Dr. Frankland's results was always on the side of excess, not in defect, and the error was often larger than the total amount of organic nitrogen said to be present in the water. In some cases organic nitrogen had been indicated by the ammonia process when none was obtained by the "gaseous method."

Mr. Dugald Campbell would not occupy the time of the Society by any remarks upon Dr. Frankland's processes which he thought required more study, consideration, and experiments than appeared to have been bestowed upon them by the gentlemen who have just spoken, but would confine himself to making a few remarks upon his own experiments upon water containing known quantities of urea and albumen,* referred to by these gentlemen. The Society will not fail to remember that Mr. Wanklyn, on behalf of himself, Mr. Chapman, and Mr. Smith, read a paper before it in June last, in which it is stated that solutions containing urea and albumen when distilled with the addition of sodic carbonate, two grammes of carbonate to a litre of water, yielded up all the nitrogen of the urea as ammonia, leaving untouched the nitrogen of the albumen to be afterwards acted upon by caustic potash, and ultimately by permanganate of potash, in order to obtain all the nitrogen as ammonia from the albumen; and in the paper it is distinctly stated that these results were arrived at by "direct experiments in which a known quantity of urea, gelatin, and albumen were taken."[*] Upon that occasion he (Mr. Campbell) had remarked that this was not his experience, and that he had never, when operating upon solutions of urea in any quantity with sodic carbonate, been able to decompose the urea thoroughly in the way they said they did, and likewise, that he never had distilled albumen with sodic carbonate without obtaining ammonia from it; both these statements were contradicted at the time by Mr. Wanklyn and Mr. Chapman, the latter gentleman detailing an experiment wherein he had acted upon a known quantity of urea with sodic carbonate, and had obtained from it all the nitrogen as ammonia: how this agrees with what is afterwards stated by these gentlemen will be seen. These results being so diametrically opposed to his (Mr. Campbell's) own experience, he was induced to make some further experiments, but before doing so he thought it advisable, as he had been operating upon rather strong solutions, to write to Mr. Wanklyn and ascertain from him what strength of solutions of urea and albumen he should employ in order to obtain results such as it was stated had been obtained by himself and colleagues; to this he got no reply, but Mr. Wanklyn called upon him in a few days, and after discussing the question, he (Mr. Wanklyn) was of opinion that their process would be fairly tried if solutions were made with fresh white of egg, containing not more than 1-10th of a grain of dry albumen in a gallon of water, and also with not more than the 1-20th part of a grain of urea in a gallon of water; and these proportions were at the time written down on a slip of paper by Mr. Wanklyn, which was in the possession of his (Mr. Campbell's) assistant until recently, but cannot now be found. From his (Mr. Campbell's) experiments above referred to, he proved that solutions of urea generally were not perfectly decomposed by sodic carbonate, as stated by Messrs. Wanklyn, Chapman, and Smith, and also that all solutions of albumen when distilled with the quantity of sodic carbonate stated by them give off some nitrogen as ammonia. To meet the first case, Mr. Wanklyn now states that pure urea in water does not give off ammonia to any great extent when boiled with sodic carbonate and caustic potash, and that albumen when boiled with half the quantity of sodic carbonate they originally proposed, only gives off a small percentage of the nitrogen in the albumen. This proves exactly what he (Mr. Campbell) had stated on hearing their paper read, namely, that sodic carbonate did not entirely decompose urea, and that when he distilled albumen with sodic carbonate with the quantity of that reagent used by these gentlemen, he never failed to get ammonia evolved. It is rather a remarkable circumstance that Mr. Wanklyn, commenting upon his (Mr. Campbell's) paper when read at the British Association at Dundee, should then have "questioned the purity of the urea employed by Mr. Campbell," and should now write "that the urea occurring in waters contaminated with sewage is not pure urea, and that the circumstance that extreme purity imparts to urea a power of resistance which impure urea does not possess, does not in the least degree impair the applicability of our method to natural waters;[†] this proposition he (Mr. Campbell) ventures to think may be quite satisfactory to Mr. Wanklyn and his colleagues, but would not after a careful consideration of all the circumstances of this case, from first to last, be acceptable to many members of this Society without proper experiments and data fully detailed, and in such a manner as to be capable of being checked by independent operators. In his (Mr. Campbell's) experiments before referred to, every endeavour was made to arrive at the truth, and if they were inaccurate to any great degree, which he can scarcely believe they were, it must be owing to the distilled water with which the standard solutions were made not having been perfectly free from ammonia, although the water he used was tested carefully for ammonia and showed none; but since he had made these experiments he had been preparing some others, but had been prevented completing them from finding it difficult to obtain water on a large scale, which, when more rigorously tested, and in a manner differently to what was done at the time he made his experiments, was perfectly free from ammonia. Without this he was disinclined to proceed, but he hoped to be able to do so soon, when he would be in a position to lay these experiments before the Society.

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* Paper read before the British Association at Dundee. See Chemical News, vol. xvi, p. 139, et seq.

Dr. Frankland could not presume to reply to all the objections raised by Messrs. Wanklyn and Chapman, but would appeal to experiment and not to argument. Since the last meeting he had, with the assistance of Mr. Armstrong, made further experiments in certain directions which were confessedly imperfect. His results were suspected of being erroneous on the side of excess, because the permanganate method furnished lower numbers in all instances, but the speaker thought he should be able to show proof to the contrary by an appeal to figures. Here were some experimental results with artificial waters:—

In 100,000 *parts of Water.*

Expt.	N. by Permanganate.	Organic Nitrogen.	N. as Nitrates and Nitrites.
I.	·016	·068	·015
II.	·016	·042	·006
III.	·022	·076	nil.
IV.	·308	1·015	nil.

No. 3 was a peaty water, made by infusion of the peat cut five feet deep at Preston, in Lancashire, and the last was a much stronger decoction of peat prepared with the aid of an alkali. The figures in the second column were obtained after treatment with sulphurous acid, and evaporation in *vacuo*. Some of this solution was then precipitated by sulphurous acid, and the resultant solid peaty matter was examined both by the permanganate and by the combustion method, when exactly twice as much nitrogen was indicated by the latter. The residual filtrate from the last product was likewise treated comparatively, and gave nearly three times as much nitrogen gas as that furnished by distillation in the form of ammonia. A still stronger infusion of peat evaporated over a steam bath gave the numbers ·422 and 1·175 respectively.

Proceeding now to natural waters, Dr. Frankland stated that the Thames showed abnormal results during the last month (January), due to the circumstance of the river overflowing its banks, and becoming not only very muddy, but highly charged with organic matters. As before, comparative experiments were made on identical samples.

Water Supply.	Quality.	N. by Mn.	Org. N.
Chelsea ..	Muddy	·011	·058
West Middlesex	Clear	·012	·027
Southwark ..	Very turbid	·024	·061
Grand Junction	Clear	·006	·031
Lambeth ..	Turbid	·030	·062

Next, with reference to the destruction of nitrates and nitrites by sulphurous acid, the speaker was to some extent prepared to admit the force of Mr. Chapman's objection; for on treating a mixture of nitre and salt with sulphurous acid only, one-third of the nitric acid was expelled, but if phosphoric acid, or ferric chloride were at the same time present, all the nitrogen of the nitrates would be expelled. The action of phosphoric acid in this case was not easily explained. Dr. Frankland concluded with a description of the behaviour of nitrogenous alkaloids under both circumstances, thus:—

	Ammonia obtained.	
	By permanganates.	By combustion.
Strychnine	·00032	·00101
Narcotine	·00031	·00063
Sulphate of Quinine	·00073	·00128

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[*] The "Journal of the Chemical Society," ser. 2, vol. v., p. 448.

[†] The "Journal of the Chemical Society, vol. v., second series," p. 394.

Such were the series of numbers afforded by the two methods of analysis; for his own part the speaker was not at all surprised at the want of accordance manifested in the several instances brought forward. He knew of no precedent in organic chemistry which would lead him to believe that nitrogenous matters should split up in a definite manner, and furnish always the same proportion of ammonia when attacked by oxidising agents. Mr. Wanklyn and himself had both encountered the same difficulty in attempting to fix the nature of the organic matters occurring in samples of water, but at any rate we were not sure of its existence as albumen, and, until something more definite were proposed, he should not be inclined to abandon the combustion process.

Dr. De la Rue said that this discussion furnished evidence of the importance to be attached to a right appreciation of the results of water analysis, and no method was now brought forward but it was immediately sifted and discussed, and the truth ultimately elicited. This was a confessedly difficult branch of analytical chemistry, and there seemed to be opportunities of further research.

Dr. Attfield had placed upon the table a sample of water from Jamaica, the constitution of which was very remarkable, and the flavour peculiar. It contained:—

	Grains per gallon.
Chloride of calcium..	1500
Chloride of sodium	1000
Chloride of ammonium	2¼

The **President** also referred to a small but powerful voltaic battery of ten cells, constructed by Dr. Hugo Müller and himself, upon a new principle. The negative element was chloride of silver fused around a central silver wire, which served as conductor; this was bent over and connected by means of a small caoutchouc band or collar, to a rod of zinc, which need not be amalgamated. The exciting liquid was salt water, which in course of time became charged with chloride of zinc, and only required to be renewed when metallic zinc commenced to deposit on the negative plate. Ten of these little couples, three inches or less in height, were mounted on a wooden frame supported and sliding upon glass uprights, so that the battery was very easily put in action; and its tension was so great that a cubic inch of the mixed gases was given off from water in about twenty minutes. Mr. Gassiot thought somewhat highly of this arrangement, and the President was now having made for further trial a battery of two hundred cells.

Dr. W. J. Russell then proceeded to deliver a lecture "*on Gas Analysis*," the report of which must stand over until next week.

An important paper, which Dr. Frankland characterised as describing "one of the greatest triumphs of modern synthetical chemistry," was next read by the Secretary. It was communicated by Professor H. Kolbe, and entitled "*Reduction of Carbonic Acid to Oxalic Acid*," by Dr. E. Drechsel. A mixture of pure sodium and dry sand was heated in a flask to the boiling point of mercury, and a rapid stream of dry carbonic acid passed. After a few hours the silvery aspect of the metal changed to a red mass, and ultimately became nearly black; towards the end the heat should be moderated to avoid reduction to carbon, and the whole slowly cooled. Left in the air for the sodium to oxidise and then exhausted with water, it furnished a solution containing oxalate of sodium. From ten parts of sodium one part of calcic oxalate was obtained. Potassium amalgam containing 2 per cent of the alkali metal acts in the same way.

A paper by Mr. W. H. Perkin, F.R.S., "*On some new Benzylic Derivatives of the Salicyl series*," was then read. [An abstract of this communication will appear next week].

The meeting was at a late hour adjourned until the 20th inst., when Mr. David Forbes, F.R.S., will deliver a lecture "*On some Points of Chemical Geology*."

NOTICES OF BOOKS.

A Manual of Inorganic Chemistry, arranged to facilitate the Experimental Demonstration of the Facts and Principles of the Science. By Charles W. Eliot and Frank H. Storer. Second Edition. London: John Van Voorst. (Pp. xiv. and 695).

The favourable reception awarded to this work in America is doubtless the immediate cause of its re-publication in England. Its plan, moreover, differs in several essential points from that usually adopted by the compilers of elementary chemical manuals in this country, since it is primarily designed directly to accompany a course of practical study in the laboratory. In some respects it resembles the once popular manual of Stoeckhardt; indeed to this book the authors avow their obligations for many experimental details. The work is not written in support of any particular theory, or in the interest of any one system of notation, the fundamental idea of its authors having been to facilitate the acquisition of a knowledge of inorganic chemistry as far as possible by, as they say, the experimental and inductive method. To this end they give a large number of experiments simple and inexpensive to perform, although perfectly adequate to demonstrate the leading facts and generalisations of the inorganic portion of the science, for the authors plainly indicate that much of the complicated paraphernalia with which our modern lecture-rooms are equipped is by no means absolutely necessary to elucidate the radical laws and principles of chemistry. These experiments are intended to be made by the student himself, and in general sufficiently minute instructions are given to insure their successful performance. We cannot, however, always compliment the authors on the elegance or clearness of the style in which these instructions are conveyed; but as an example of the character of the experiments we quote the following method of demonstrating that ammonia is actually produced from materials which are proved to generate a mixture of hydrogen and nitrogen, since a more direct synthesis is still a desideratum (p. 79).

"Exp. 45. Place in an ignition-tube an intimate mixture of 3 grammes of fine iron filings with 0·2 grammes of caustic potash; adapt a delivery-tube to the ignition-tube, heat the contents of the tube over the gas-lamp, and collect the gas which escapes in a test-tube over the water-pan. Examine this gas, which will prove to be the inflammable hydrogen. Caustic potash, as we have already learned (p. 74), consists of potassium, hydrogen, and oxygen; at a high temperature, metallic iron is able to seize upon a portion of the oxygen in this compound, setting free hydrogen, which finds no place in the new combinations.

"Exp. 46. Heat in a second ignition-tube, similarly disposed, a mixture of 3 grammes of fine iron filings and 0·2 grammes of nitrate of potassium, and collect the gas, as before, over water. This gas has neither taste nor smell, and when tested with a lighted splinter it is found to be uninflammable, and in fact to extinguish the taper. It is nitrogen. Nitrate of potassium contains, as has been already stated (p. 75), potassium, nitrogen, and oxygen; at the high temperature employed, the salt is partially decomposed, the metallic iron combines with the oxygen of the nitrous vapours formed, and their nitrogen is set free.

"Exp. 47. In a third ignition-tube, heat the same quantities of the same materials which have been used in the last two experiments, at once and together. A delivery tube is not necessary in this case; the tube may be held by the wooden nipper by the open end. Neither hydrogen nor nitrogen will be evolved as before, but instead of them we have ammonia, whose presence may be manifested by holding a bit of reddened litmus paper at the mouth of the tube. The intense alkaline reaction of the gas, and its odour, sufficiently distinguish it from both hydrogen and nitrogen."

The authors, however, clearly discriminate between chemistry and chemical manipulation, and give, in the form of an appendix, very practical instructions on the latter subject.

Many arguments may be adduced in support of such a method of instruction—arguments, too, which would probably have greater weight now than formerly, when the practical study of physical science was ignored and banished from the ordinary *curricula* of our schools. Not the least weighty of these arguments will be found in the incontestable fact that this method necessarily tends to discipline and develope the student's perceptive faculties—one of the capital results of a well-devised method of teaching physical science. The student is enabled directly to examine for himself—to see, smell, and handle for himself—and he thus becomes acquainted with the main facts of the science by a process similar to that by which the facts themselves were originally perceived and established. Everyone will readily grant to the authors that scientific study fails of its true end if it become a mere exercise of the memory. Moreover, such a method, above all, materially facilitates the attainment of a definiteness and exactitude in the knowledge of the subject, without which, as an authority on this matter has recently declared, the introduction of physical science into our school system is worse than useless; and although chemical lecture illustration has never been carried to such a degree of perfection as at this time, when our professors appear almost to base their reputation, in the lecture theatre, on the brilliancy and effectiveness of their demonstrations, we venture to assert that under the present system of science tuition this exactitude is by no means so generally acquired as it ought to be. The result to the student is not commensurate with the labour of the teacher. Doubtless, the evil to some extent is inherent in the system, but much of the ill-success, it seems to us, is to be directly ascribed to the student. The almost universal complaint of teachers, even in this age of the multiplication of manuals, is that students, as a rule, will not sufficiently study their text-books. An undue prominence is given to the teaching in the lecture-room; by some it is invested with a value which it cannot in strict reason intrinsically possess. There is a proneness to regard the text-book as merely supplementary to the lecture. Even the most conscientious students err in considering they gain their object merely by a regular attendance in the class-rooms, unremitting attention to the lecturer, and a careful transcript of their voluminous notes at leisure. But how is it possible for the student mentally to digest the lecture when his sole aim is apparently to get a verbatim report of it? How frequently in the hurry of mechanically noting the definition of a principle, or the description of a property, does the student miss the point of the experiment by which the one or the other is intended to be illustrated? That *ex abusu non arguitur ad usum* everybody knows; but the practice of note-taking is often carried to an injudicious excess, and operates injuriously against both the teacher and the taught.

Hence it appears to us that the method employed in this book will go far to obviate this tendency, and we venture to predict that manuals based on this or a similar plan will multiply with the more general introduction of the practical study of physical science into our school system.

The authors presuppose the students of their manual to be already acquainted with the rudiments of physics, and, therefore, contrary to the practice which obtains in England, they plunge at the very outset *in medias res*. Still, as they have thought fit to recapitulate at length many of the physical properties of bodies, it would, we take it, have been well to have directed the student's attention to the natural effects of many of these properties—to the beneficial consequences resulting from the singular anomaly of water possessing a condition of maximum density, for example. And, as the question at issue between Tyndall and Magnus is apparently settled at last, we also regret that all mention of the effect of atmospheric moisture in retarding and modifying the intensity of solar radiation is omitted. Every true student of physical science knows the quiet innate sense of enjoyment to be derived from the knowledge and contemplation of such phenomena.

We observe that the statements of the older manuals with respect to the existence of definite hydrates of the so-called "mineral" acids are repeated, although Roscoe and Dittmar showed some years ago that the uniformity of the composition of these bodies was only apparent, and in reality an accidental circumstance depending simply on the pressure under which their distillation had been effected; they proved that for every pressure an aqueous solution exists which, when distilled under that pressure, possesses a constant boiling point and fixed composition.

The chapter on antozone is mainly made up of the vague and unsatisfactory statements of Meissner and Houzeau. The authors, however, plead in extenuation for thus setting forth whatever is known respecting antozone, "the impossibility with so obscure a subject of making such a just discrimination between salient and unimportant points as with a well studied subject is both easy and desirable." In our opinion, there is but little satisfaction to the unfortunate student who is thus shown "how vague and uncertain the prospect is when once the narrow limits of established knowledge are past, and the inquirer ventures out into the obscurity which perpetually separates the knowledge of to-day from that which shall be knowledge to-morrow" (p. 154).

In taking leave of a work to which it gives us pleasure to direct attention, we cannot refrain from quoting the following just discrimination of the relative position and value of fact and theory:—"In the midst of the doubts and discussions which to-day envelope chemical theories, the student will do well to remember that all these questions lie without the sphere of fact. They do not affect the actual composition or properties of a single element or compound; they are questions of interpretation, classification, and definition. The existence of atoms is itself an hypothesis, and not a probable one; all speculations based on this hypothesis, all names which have grown up with it, all ideas which would be dead without it, should be accepted by the student provisionally and cautiously, as being matter for belief but not for knowledge. All dogmatic assertion upon such points is to be regarded with distrust. The great majority of chemists, devoted to the applications of chemistry in mineralogy, metallurgy, dyeing, printing, and the manufacture of chemicals, remain completely indifferent to discussion of chemical theories. Hence the student will find that in technical chemical literature the older notation and the corresponding smaller atomic weights are almost invariably employed. Theories, however, are of great importance to the progress of the science and to the clear ordering of the ground already won. It is on this account very much to be wished that the great attention now devoted to the discussion of the best methods of representing symbolically the constitution of chemical substances and the changes to which they are subject may result in the elaboration of a system good enough to command general acceptance."

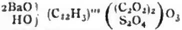
Blowpipe Vesicular Reactions.—Captain Ross desires us to state that the colouration of borax and P. salt by certain substances, is so *extremely delicate* when it is blown into a vesicle, that he believes many new reactions of metals will soon be made under this head. In the meantime, the two following additions may be confidently made to the blowpipe tables of Plattner and others:—

Silver (oxide of)—**In Borax.**—Opaline by *reflected* and a beautifully delicate pink colour by *transmitted* light. (No other substance can be mistaken for this.)

Tungstic Acid (in *Wolfram*)—**In Borax.**—A peculiar *amber-yellow*, which cannot possibly be mistaken for the yellow given by oxide of iron.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

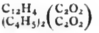
Sulphophtalic Acid.—O. Loew. This compound is obtained by heating phtalic acid with sulphuric anhydride to 100° or 105°C. in a sealed vessel. The products of the reaction are dissolved in water, neutralised with plumbic carbonate and the plumbic sulphophtalate, which remains in solution, is decomposed with hydric sulphide. The composition of the baric sulphophtalate corresponds to the formula—



$$\left.\begin{matrix}2BaO\\HO\end{matrix}\right\}(C_{12}H_3)'''\begin{pmatrix}(C_2O_2)_2\\S_2O_4\end{pmatrix}O_3$$

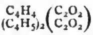
—(*Ann. Chem. Pharm.* cxliii. 257.)

Phenylenediethylacetone and Ethylenediethylacetone have been obtained by G. Wischin, by acting upon phtalic and succinic chloride with zincic ethide. Phenylenediethylacetone



$$\begin{matrix}C_{12}H_4\\(C_4H_5)_2\end{matrix}\begin{pmatrix}C_2O_2\\C_2O_2\end{pmatrix}$$

is soluble in ether and alcohol, insoluble in water. An ethereal solution yields large crystals on slow evaporation. Ethylenediethylacetone



$$\begin{matrix}C_4H_4\\(C_4H_5)_2\end{matrix}\begin{pmatrix}C_2O_2\\C_2O_2\end{pmatrix}$$

is a pale yellow liquid. Neither of the two acetones combine with alkalic disulphite.—(*Ann. Chem. Pharm.* cxliii. 259.)

Action of Ethylene on Sulphuric Oxychloride.—F. Baumstark. Sulphuric oxychloride absorbs ethylene with disengagement of chlorhydric acid. A thick brown oil is formed which presently solidifies, and on being treated with water, yields anhydride and acid of isethionic, and a new acid of the composition $C_2H_8SO_6$. The latter is obtained as a syrup which gradually assumes crystalline condition. Its salts mostly crystallise well. If sulphuric oxychloride is treated with an excess of ethylene, it takes up 2 mol. of the latter, and a yellow oil is formed, the smell of which resembles that of oil of mustard. It boils at 154° C.; its composition is $C_2H_5SO_3Cl$. It decomposes on exposure to air, separating at the same time into two layers, the upper of which being an oil of the composition $C_4H_{10}SO_5$. The action of dry ammonia upon $C_2H_5SO_3Cl$ gives rise to the formation of a well crystallising body of the composition $C_2H_7SO_3$.—(*Zeitschr. Chem.*, N.F. iii. 566.)

Conversion of Hydrocarbons into Ketons.—E. Linnemann has continued his experiments on the conversion of monobromated hydrocarbons of the C_nH_{2n} series into ketons of fatty acids of the same number of carbon atoms, and extended them to ethylene, propylene and amylene. The reaction the author makes use of consists of an oxidation by means of mercuric acetate. In the case of ethylene only traces of aldehyde could be detected. The proportions of ketone obtained from propylene and amylene were likewise very small, acetic acid being the principal product of the reaction in all cases.—(*Ann. Chem. Pharm.* cxliii. 347.)

Iodides of Organic Bases.—S. M. Jörgensen has prepared and examined the superiodides of a great number of organic bases, more especially those of strychnine and brucine, and also such of their derivatives as contain besides iodine an alcohol radical. The former were generally prepared by precipitating a salt of the base with a solution of iodine in potassic iodide, the latter by mixing alcoholic solutions of the base, and iodide of alcohol radical. All these compounds are obtained in brilliant crystals from their alcoholic solutions. For detail the reader must be referred to the original paper.—(*Ann. Chim. Phys.* [4] xi. 114.)

CORRESPONDENCE.

BEET-ROOT SUGAR.

To the Editor of the Chemical News.

Sir,—Your foreign correspondent in yesterday's number remarks, "as the manufacture of beet-root sugar is not an English industry, an abstract of this memoir would probably possess little interest for your readers." As the manufacture of beet-root sugar will probably be commenced this year, in more than one locality in England, all information respecting it will be peculiarly valuable at a time when the best processes should be at once adopted. Your correspondent in Paris, by communicating the earliest information, will probably be conferring great benefit on an industry which will in all probability soon become of national importance.

If you can obtain for me the title of the best and most recent French works on the growth of the sugar beet, and the manufacture of sugar from it, you will greatly oblige.—I am, &c.,

Robert Oxland.

Compton Gifford, Plymouth, February 8th, 1868.

THE RECENT DISCUSSION AT THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—Having only renewed—not commenced—the discussion at the last meeting of the Chemical Society, I believe that I had no right of reply at the end of the discussion.

Mr. Campbell's remarks, however, demand an answer. Mr. Campbell stated that I had not published a single experiment in which I took white of egg, and failed to get ammonia from it on boiling with dilute solution of carbonate of soda.

I quote a passage from my paper (*Laboratory*, 28th September, 1867, page 442), and make the remark that Mr. Campbell had read that paper.

"III. A litre of spring water, 1·864 grm. of carbonate of soda, and 3·5 milligrm. of fresh white of egg (weighed on a bit of platinum foil), were introduced into a retort and distilled:—

1st distillate,	100 c.c.	= 0·000	milligrm.	NH_3
2nd ,,	100 c.c.	= 0·000	,,	,,
3rd ,,	100 c.c.	= 0·000	,,	,,
		0·000"		

This extract speaks for itself, and is surely sufficient to justify my interruption of Mr. Campbell's speech.

Equally contrary to the fact, is Mr. Campbell's representation that the dispute between us was whether traces of white of egg (not a considerable proportion) were decomposed.

If your readers will turn to Mr. Campbell's paper (*Lab.*, September 21st, 1867), they will find that according to Mr. Campbell, he got off about 33 per cent of the total nitrogen in the form of ammonia, when he boiled 0·093 grain of (moist) white of egg with dilute carbonate of soda, and that on taking still more dilute solutions of albumen *all* the nitrogen came off as ammonia.

In my reply (*Lab.*, 28th September, 1867), your readers will find the following:—

"I have thus taken 5·00, 0·40, and about 0.04 milligrm. of *albuminoid* ammonia in the shape of white of egg, and in no case got over two and a half per cent of the albuminoid ammonia evolved by carbonate of soda."

Mr. Campbell's paper is of a piece with his speech, According to him he took a quantity of urea, containing nitrogen equivalent to ·0062 grain of ammonia, and having boiled it with dilute carbonate of soda, then with potash.

and finally with permanganate of potash, got altogether .0061 grain of ammonia, ·0015 grain of this ammonia being evolved by the permanganate. In a second experiment, he describes himself as having taken the same quantity of urea, and obtained accurately ·0062 grain of ammonia, this time ·0025 grain by the permanganate. When I add, that since the publication of Mr. Campbell's paper, the observation has been recorded, that boiling with alkaline permanganate actually oxidises urea, and evolves its nitrogen, in great part, as nitrogen gas, or as nitric acid, the character of these experiments of Mr. Campbell's will become intelligible. Notwithstanding this oxidation, Mr. Campbell finds accurately all his nitrogen in the form of ammonia.—I am, &c.,

J. ALFRED WANKLYN.

London Institution, February 8th, 1868.

MISCELLANEOUS.

Chemical Society.—The following lecture arrangements have been made:—February 20th, "On Chemical Geology," by David Forbes, F.R.S., F.G.S., F.C.S. On March 19th, "On the Manufacture of Glass," by Henry Chance, M.A., "On Steel direct from the Ore," by C. W. Siemens, F.R.S.

Soiree of the Chemical Society.—The President has issued invitations for a soirée, on the evening of March 11th, 1868, at Willis's Rooms. Gentlemen who are willing to send contributions, are requested to describe their nature to the Secretaries of the Chemical Society, Burlington House, so that arrangements may be made for properly displaying them. All contributions must be delivered and arranged before 2 p.m. on the 11th, and removed before 11 a.m. on the following day.

Obituary.—We have this week to record the decease of another of our greatest philosophers—Sir David Brewster,—who died on Monday evening, at Allesley House, near Melrose. To Sir David we owe many of the vast researches made in physical science. Commencing his scientific career at the University of Edinburgh, he very quickly had the honorary degree of M.A. conferred on him, and a few years afterwards was elected a Fellow of the Royal Society of Edinburgh. In 1815 he gained the Copley medal of the Royal Society, for a valuable paper on the "Polarization of Light by Reflection," and was also elected a Fellow. He afterwards gained the Rumford medal for further discoveries relating to the polarization of light, and the Keith prize from the Royal Society of Edinburgh, for his discovery of two new fluids in minerals, and his analysis of solar light. He was also a member of most of the foreign academies. In 1831 Sir David proposed the scientific meeting at York, which resulted in the establishment of the British Association for the Advancement of Science. During the same year he received the honour of the Hanoverian Guelphic Order, and in 1832 he was knighted by William IV. We here cannot but express our surprise that no greater honour than knighthood can be conferred on such men as Sir David Brewster and Sir Charles Wheatstone, whose discoveries have added so much to the wealth and prosperity of our country. Sir David Brewster retained his love for science to the last, almost weekly contributing papers to the scientific journals.

Improved Spectroscope.—Professor Osborn, of Lafayette College, Easton, Pa., has made improvements in the spectroscope, by which it may be readily applied to a variety of practical purposes, especially in metallurgical operations. In a letter to the *Scientific American*, he says:—"The instrument complete is so arranged that the observer reads the degree on the scale by the actual light which he is analysing. The very light which comprises, in its flame, the vaporized metal, as lime, iron, chromium, titanium, sodium, &c., discloses to the observer in the spectral form its own nature, not only, but often to a great degree, the approximate quantities found in the original ore or even in the coal used, or from the wasting brick of the furnace. Nothing can exceed the beauty of the spectral forms which suddenly appear and disappear in the otherwise darkened tube, as the observer stands at the 'tunnel head' of the furnace, watching, as it were, the spectral secrets of that terrible flame which pours forth from the stack, especially when, after the 'cast' and consequent cessation of the blast, that blast is again turned on. The bright yellow bar of sodium is almost always present during examination of all flames resulting from the use of any and all forms of anthracite in the furnace and forge, or from decomposing soda feldspars. But one of the most striking facts in my examinations occurred at our last analysis of a flame from a re-heating furnace on the Lehigh, at the wire works of Stuart & Co. The workmen held partly out a bar of intensely heated iron on the hearth of the furnace, when, at rapid intervals, the dark lines which are seen in the solar spectrum appeared faintly, but certainly flitting over the spectrum of the fierce flame by which the intensely heated iron was enveloped. An instrument, of a circular form, is in course of construction, under my direction, for the easy examination of these flames, and which may be used at any time and at considerable distances, and I am hoping that such shall be its sensitiveness that the furnace master may sit in his room and know much of the efficiency and value of the operations proceeding at the furnace by its use. I am situated on a hill, and by means of my instrument, placed upon my dinner table, I can get a beautiful spectrum from a reheating furnace situated not much less than a half-mile from my instrument, and am able to detect the sodium in the coal, or from the decomposed fire brick, and also any lime, potash, &c., which proceeds from the furnace mouth. I have no doubt that some exceedingly important uses may be made of this discovery of the spectroscope in the line of metallurgical operations."

Nitroglycerine and Greek Fire.—We have been requested to publish the following memorandum, which has been prepared under authority, and has been issued by Lieutenant-Colonel C. B. Ewart, R.E., by order of the Secretary of State for the Home Department:—"Nitroglycerine is not applied as an incendiary agent, and, if used as an explosive, it will not be scattered loosely about, but will be employed in cans or other closed vessels. If such should be discovered, they should be carefully removed, some heavy body should be attached to them, and they should be thrown into deep water, without any attempt being made to open them. True Greek fire is simply a solid highly combustible composition, very similar to 'Carcass Composition.' What is now commonly called Greek fire consists of a solution of phosphorus or of sulphur and phosphorus in a very volatile liquid, the bisulphide of carbon, to which occasionally some mineral oil is added with the view of increasing its incendiary powers. When this liquid is thrown on to any surface exposed to the air, the solvent evaporates, leaving a film of the phosphorus or sulphide of phosphorus, which will then inflame spontaneously, but will not very readily set fire to wood or combustible materials. The proper mode of extinguishing the flame produced by such an incendiary agent is to throw upon the burning surface a quantity of wet or damp sand, ashes, sawdust, lime, or any other powder, or wet sacking or carpeting, any material, in short, by which the flame can be stifled by exclusion of air. No attempt should be made to remove the covering for some time after the flame has been extinguished. The place should afterwards be thoroughly scoured by playing upon it for some time with a powerful jet of water. Should any scattered liquid be discovered which has not become inflamed, it should be washed away, as above directed, as quickly as possible; and if a jet of water is not immediately at hand, it should in the meantime be covered in from the air by application of any of the materials named above."

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Journal des Fabricants de Papier.
October 1, 1867.

E. Bourdilliat, "On Testing the Materials and Chemical Products used in Paper Making." (Continuation.) "Detection of the various Fibres used in the Manufacture of Paper." "A Method of ascertaining whether a paper has been Sized with Gelatine or Resin."

Journal für Praktische Chemie.
October, 1867.

Carstanjen, "On Thallium and its Compounds." J. Lowe, "On the Transformation of Gallic Acid into Tannic Acid." H. Baumhauer, "On the Production of Light during the Oxidation of Potassium and Sodium when exposed to the Air." K. Frisch, "On the Composition of the White External Coating, and of the Black Inner Mass of a Flint from the Island of Rugen."

Comptes Rendus.
November 4, 1867.

Sir D. Brewster, "Letter to Chevreul on the Nature of the Relations which existed between Newton and Pascal." Chasles, "On the same Subject." Becquerel, "Third Memoir on some newly discovered Electro-Chemical Effects of Capillary Action." E. Peligot, "On the Distribution of Potash and Soda in Plants." E. Bouchotte, "On the Dialysis of Induction Currents." C. Blondeau, "On the Action of Induction Currents on Plants."

November 11.

Sir D. Brewster, "Letter to Le Verrier on the Nature of the Relations which existed between Newton and Jacques Cassini." "Letter to Chevreul on the Authenticity of the Newton and Pascal Correspondence." Balard, "On the same Subject." Chasles, "Answer to Sir David Brewster's two Letters on the Nature of the Relations which existed between Newton and Pascal." Grant, "Letter to Le Verrier on the Astronomical Observations of which Newton and Pascal may have made use." F. Laroque, "On the Penetration of Air Bubbles into a Liquid on the Passage of a Projectile into the same." Velter, "On the Value of Sea-Salt as Manure by reason of its Transformation into Carbonate of Soda, and finally into Nitrate of Soda." F. Bellamy, "On the Use of Subsulphate of Alumina for detecting and estimating certain Organic Matters in Water." H. Schiff, "On Condensed Ureas." A. Bobierre, "On the Manufacture of Chloride of Lime, and on Chlorimetry." C. Mene, "An Analysis of some Samples of Coal from Prussia."

November 18, 1867.

Sir D. Brewster, "Letter to Chevreul on the Authenticity of the Newton and Pascal Correspondence." Chasles, "Answer to R. Grant's further Communication on the Newton and Pascal Correspondence." A. Gautier, "On some new Nitriles of the Fatty Series." De Romilly, "On the Preparation of Cyanides."

Poggendorff's *Annalen.*
October, 1867.

R. Ruhlmann, "Researches on the Effect of Temperature on the Velocity of Light in Water." G. Quincke, "Optical Researches." 9. "On Jamin's Compensator, and on a new Method of Determining the Refractive Index of Glass Plates for different Lines of the Spectrum." C. Freese, "On the Combinations of Iron with Phosphorus." L. Sohncke, "On the influence of the Motion of a Source of Light on the Refraction of the Light emitted, being some Critical Remarks on Professor Klinkerfues' Recent Discovery."

Bulletin de la Société Chimique de Paris.
October, 1867.

Berthelot, "Answer to Fritzsche's Remarks published in the *Bulletin de la Société Chimique* for September, 1867, on the Author's Paper on Anthracene." Berthelot, "On the Hydrocarbons of Coal Anthracene. Fluorene. Acenaphthene or Tar; Styrolene; Cymene. Hydrides of Naphthalene. Acetylonaphtalene." Wiederhold, "A new Green, derived from Linseed Oil and Oxide of Copper." Bernard, Scheurer, and Tempe, "A new Process for the Extraction of Indigo from Dyed Woollen and Cotton Rags." Bernard, "A new Process for Dyeing Stuffs Turkey Red."

Journal für Praktische Chemie.
November, 1867.

Carstanjen, "On Thallium and its Compounds." C. F. Schonbein, "On the Transfer of the Oxygen absorbed from the Atmosphere by Turpentine and similar Organic Substances to Water." "On the Presence of Active Oxygen in Organic Substances: 1, on the Quantity of Ozone contained in Blue Guaiacum Wood. 2, on the Free-Active Oxygen of Quinone. 3, on the Combination of Cyanine with Ozone, 4. On the Combination of Olefiant Gas with Ozone." "Researches on Guaiacum Resin." "On Brasilin and on its Fluorescent Properties." J. Wolff, "On Two new Derivatives of Aniline." W. Stein, "Contributions to the Knowledge of Orellin, a Yellow Colouring Matter derived from *Bixa orellana*." Otto, "On the Characters of Thallium, and on the Metallic Group to which it belongs. G. Vorbringer, "A Method of producing a Black Pharaoh Serpent."

Dingler's *Polytechnisches Journal.*
November, 1867.

O. Zabel, "An Electro-magnetic Apparatus for regulating the Temperature at which Substances are dried in Chemical Operations." G. Lunge, "On the Analysis of the Materials used in and of the Bye-Products of the Manufacture of Soda." E. Brescius, "On the Simulation of Arsenic by Chloride of Zinc in Marsh's Test, and on the Detection of Arsenic and Antimony in Hydrochloric Acid."

NOTES AND QUERIES.

Sulphite and Hyposulphite of Soda.—Can any of your correspondents enable me to discover the consumption of sulphite and hyposulphite of soda in England, and also its uses.—G. W. R., Liverpool.

Chlorimetry.—Is it possible to devise a ready way of estimating the chlorine in a solution of bleaching powder containing a large proportion of nitrate of lime?—S.

Price of Sulphuric Acid.—Perhaps some reader of the Chemical News can inform me what price I ought to pay for sulphuric acid of 1·6 specific gravity, supposing I pay £4 per ton specific gravity, 1·72.—V. C.

Swedish Cooking Apparatus.—I see you ask the address of the inventor of the Swedish, or rather Norwegian, Cooking Apparatus. It is Mr Sörensen, 13, Duke Street, Grosvenor Square, W. I can vouch, from my own use, for the practical efficiency of this simple converse of a refrigerator.—Marshall Hall, 3, Cleveland Terrace, Hyde Park, W.

Portable Cooking Apparatus.—In the Chemical News, "To Correspondents," I note "Swedish portable cooking apparatus," and it occurs to me that a knowledge of a lamp I fortunately came across in Scotland, and took with me to Iceland, might prove interesting to travellers; though I may be describing what you have seen. The lamp is of copper, and is partly filled through the cock with methylated spirit, the tap closed, and a little spirit poured into open centre and lighted—the flame soon warms the sides and top of the lamp, and the consequent expansion of the vapour inside presses the spirit in a strong jet from a bent tube connected with bottom of spirit chamber, which lights, and increases the heat of the lamp, thus getting a stronger flame. Mine would boil a pint of water in five minutes, and use from one to one and a half ounce spirit.—John Cliff.

The Sprengel Air-pump.—"Ein Englander" will find a paper entitled "Sprengel's Researches on the Vacuum," wherein his mercurial air-pump is described, in the January number, 1865, of the *Journal of the Chemical Society.* With an instrument of total height of about 6 feet, and from 10 to 15 lbs. of mercury, a receiver of half a litre capacity may be exhausted in from 20 to 30 minutes: the fall tube must not be of greater calibre than 3 millimètres, and had better be of 2½—2¾ millimètres only.—C. R. A. Wright, B.Sc.

Sulphur in Pyrites.—In answer to F. W. W, I beg to point out that if it is *not* required to obtain the absolute quantity of sulphur met with in pyrites, a pretty near estimate of the value of the mineral for use in the manufacture of sulphuric acid may be obtained by taking a fair average sample of the pyrites ground to an impalpable powder, weigh off 25 to 30 grains, and expose these on a flat platinum dish, best in a thoroughly heated muffle to pretty strong incandescence for two or three hours; if no muffle is at hand a good gas flame will answer, and after cooling the loss in weight may be taken; but this method is *not* to be used but as an approximative estimation; the analysis of pyrites for sulphur requires many precautions to yield good and reliable results; of course the sulphur is oxidised to sulphuric acid, and the latter estimated, and from this result the amount of sulphur is calculated.—Dr. A A.

MEETINGS FOR THE WEEK.

Tuesday.—Royal Institution, 3. Professor Tyndall, "On the Discoveries of Faraday."
Wednesday.—Meteorological, 7.
— Society of Arts, 8.
— London Institution, 6½.
Thursday.—Royal Institution 3. Professor Tyndall, "On the Discoveries of Faraday."
— Royal, 8½.
— Zoological, 4.
— Chemical, 8. "On Some Points of Chemical Geology," By David Forbes, F.R.S., F.G.S., F.C.S.
— Royal Society Club, 6.
Friday.—Royal Institution, 8. Rev. M. W. Mayow, "On Macbeth and Hamlet."
Saturday.—Royal Institution, 3. Professor Roscoe, "On the Non-Metallic Elements."

TO CORRESPONDENTS.

Communications have been received from Johan Sörensen; J. Cliff; O. Hopkinson; J. Rugeley; F. L. Bigg (with enclosure); A. Chorlton; E. Whittingham; Professor Wanklyn; E. F. Jones (with enclosure); R. Oxland; Dugald Campbell; H. Bird; W. Ellis; T. E. Thorpe; H. Stephenson (with enclosure); J. Dempsey; W. Schofield; F. Sarl (with enclosure); W. Harding; W. Valentin (with enclosure); M. Phillips; E. Smith; E. B. Marten (with enclosure); W. Hofmann; O. Kerl; H. J. Helm; Marshall Hall; H. R. Williams & Co.; W. Bird Herapath, M.D., F.R.S.; J. Taylor; Lord Sackville Cecil; A. H. Allen; J. Marples; J. C. Lee; F. Shaw; D. Forbes, F.R.S. (with enclosure); Mottershead & Co.

Books Received.—"Chemical Notes for the Lecture Room. On Heat, Laws of Chemical Combination, and Chemistry of the Non-Metallic Elements," by Thomas Wood, Ph.D., F.C.S., 2nd edition. London: Longmans & Co.; "The Transference of the Telegraphs to the State," by John Stephen. London: Longmans & Co.; "Brief Extracts of Reports on Boiler Explosions in 1867," by Edward B. Marten; "Minutes of Proceedings at the Extraordinary Meeting of Shareholders of the Atlantic Telegraph Company"; "Réforme Scientifique."

Paris Exhibition Two Gold Medals.

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London: Robert Hardwicke, 192, Piccadilly.

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CRYSTALLOGRAPHY AND THE BLOWPIPE.

By Captain W. A. ROSS, R.A.

Some new and apparently incontrovertible facts deducible from the vesicular reactions observed and recorded by me, would seem to be :—

1. *Every* inorganic substance, chemical or mineralogical, crystallises inevitably from its solution in borax.

2. These crystallisations are *not* isomorphous.

3. Those substances which crystallise soonest are most deliquescent.

4. Crystallisation *always* precedes deliquescence.

5. Alkaline are more crystallisable and more deliquescent than acid salts.

6. There seem to be *two distinct kinds* of crystallisation in nature, having widely differing forms. One, the primary kind, in which every element and every combination of elements has a crystalline form *peculiar to itself*; the other, or secondary, the aggregate of many primary forms, in which the crystals are for the most part isomorphous, as recorded by Mitscherlich. Supposing this hypothesis correct, snow and ice are familiar examples in which the difference of the snow crystals would correspond to some difference in the composition of the drops of water of which they are formed. Whatever may be the value of these deductions, there can be no doubt that in order to describe vesicular crystallisations, a very different nomenclature must be employed from that uesd in crystallographical works.

I soon found also, from the extraordinary resemblance of most of these new crystalline forms to those of the vegetable world, that the only glossology applicable to them would be one derived from that used in botany. I therefore propose, with great deference, the adoption of the following terms to enable observers to record their observations until some more complete or better system may be enunciated :—

A. *With reference to the Vesicle.*

1. ***Diaphanous***, quite transparent ; (D.)
2. ***Diaphanebulous***, slightly clouded, but partially transparent ; (D.N.)
3. ***Diaphachromous***, clear, but coloured ; (D.C.)
4. ***Diaphanunctuous***, clear, but having a moist or oily look ; (D.U.)
5. ***Nebulous***, clouded over thickly, crystals not distinguishable ; (N.)
6. ***Nebulunctuous***, clouded, and having a moist or oily look ; (N.U.)
7. ***Lumenebulous***, clouded, but crystals distinguishable by transmitted light ; (L.N.)
8. ***Chromenebulous***, in which the vesicle is at first *Diaphanous*, but colouring matter appears in the crystals afterwards ; (C.N.)

B. *With reference to the crystals.*

1. ***Zonate***, having rings, like exogenous wood ; (Z.) *Ex.* Some of the metals of Group 3 in chemistry.
2. ***Areolate***, an aggregation of zonate crystals, like a tesselated pavement ; (A.) *Ex.* Magnesium.
3. ***Acrogenate***, fern shaped ; (Ac.) *Ex.* Cerite, &c.
4. ***Aciculate***, like needles ; (Aci.) *Ex.* Antimony.
5. ***Campanulate***, like the flower *convolvulus* ; (C.) *Ex.* Soda.
6. ***Ciliate***, having fine hairs or fringe at the margin ; (Ci.) *Ex.* Lead.
7. ***Discoidate***, like a disc of polished steel ; (D.) *Ex.* Tungstic acid—in Wolfram.
8. ***Dendroidate***, like winter trees ; (De.) *Ex* Silicates of the alkalies.
9. *Discoistellate*, discs having a star in the centre ; (D.S.) *Ex.* Potash.
10. *Digitate*, fingered ; (Di.) *Ex.* Apophyllite.
11. *Filiformate*, thread-like ; (F.) *Ex.* Silicic acid.
12. *Florate*, flower-like ; (Fi.)
13. *Guttate*, small irregular rings ; (G.) *Ex.* Chloride of platinum.
14. *Grammate*, like hieroglyphical letters ; (Gr.) *Ex.* Arsenic.
15. *Hypocrate*, salver shaped ; (H.)
16. *Macculate*, large irregular rings ; (M.)
17. *Palmate*, like the leaves of a palm tree ; (P.)
18. *Plumosate*, feather-like ; (Pl.)
19. *Reticulate*, a net-work of veins ; (R.)
20. *Stellate*, like a star ; (S.) *Ex.* Silver.

It will be seen that among the examples given I have left some deficient. This has occurred precisely from the want I am now endeavouring to supply—a *systematic* arrangement of observation and record. I wrote every one of the above terms (taken chiefly from "Lindley's Botany") with reference to some particular vesicle, but in some cases I did not apply my new arrangement to the vesicle described, and have now therefore forgotten to which vesicle the example refers ; in others the crystals were not sufficiently developed, and have altered slightly, as in the case of silica, or I have now placed the crystal under another denomination found afterwards, which I consider more expressive of its appearance. Silica at first appeared like a number of short marks or hieroglyphics scattered over the vesicle at hazard, these shortly after grew into elegantly grouped filaments or threads, having something like the appearance of minute branches or twigs of a tree, and I am therefore half inclined to change the term for silica again to "dendroidate."

It is obvious therefore that it is only by the agreement of different observers, *pursuing the same system of observation and using a similar glossology*, that the real value of these crystallisations as analytical agents will be obtainable. I am all but convinced now, not only that these primary crystallisations are isomorphous, but that the slightest change in any of the constituents of a salt will exhibit a corresponding difference in some part of the primary crystallisation. Thus *caustic* potash combined with silica only, clouds over (*i.e.*, crystallises), deliquesces, and indeed vanishes almost immediately after it is formed. In borax it clouds over unctuously, and shows discoistellate crystals. *Carbonate* of potash clouds over, and deliquesces in a very considerably longer time, and the crystals are also distinctly referable to the term *discoistellate*. *Chloride* of potassium clouds over very shortly also, but there is apparently no deliquescence, and no crystals are distinguishable. The first, second, and third of these vesicles I therefore call *nebulunctuous*, the fourth *nebulous*. Again, the only substance the formation of whose crystals I have yet found to colour the previously diaphanous vesicle is ferrocyanide of potassium. A chemical gentleman and myself imagining that the cyanogen could not possibly have been retained under the heat of the blowpipe flame in charging the borax bead, I blew a vesicle containing carbonate of potash, and a saturation of oxide of iron, but the result was a *diaphachromous* instead of a *chromenebulous* vesicle, and the crystals were different, although both exhibited the discoistellate forms of potash.

Thus, if these crystals, as I believe, respond to the very slightest change made in the composition of their ocmponent parts, but remain isomorphous *as long as these component parts are inviolably maintained*, it is evident that nothing could be more invaluable to the chemical analyst than reactions so delicate as these, made by the hand of nature herself.

I have now to record a circumstance so remarkable that I almost hesitate to put it on paper, and yet I believe it to be a fact, namely, that most, if not all the metals under Group III. of the chemical arrangement, not only produce, as I stated in my last paper, zonate discs like sections of exogenous wood, but that these rings *actually grow, each in a certain time, exactly as they do in wood, substituting weeks or days for years, so that the age of one of these crystals can be ascertained like that of a tree.*

I will now, with your permission, make a few remarks regarding *molybdenum.* The powdered ore *molybdenite* yielding on several occasions a *nebulous* vesicle in as short, if not a shorter time than the alkaline earths, I was led to examine this metal more closely than I would otherwise have done. Professor Bloxam says in his valuable work on chemistry (page 393) "The bisulphide of molybdenum (*molybdenite*) is roasted in air *at a dull red heat*, when sulphurous acid is evolved, and *molybdic acid* (MoO_3) mixed with oxide of iron is *left*." but both myself and Mr. Charles, chemical assistant at the R.A. Institution at Woolwich, failed to drive off completely the SO_3 from this ore after ten minutes or quarter of an hour of the strongest roasting in a fierce blowpipe flame. I however obtained in a pipe-clay crucible, from this process, crystals of the so-called "molybdic *acid*." On rubbing these crystals with moistened test-papers, they gave neither an acid nor alkaline reaction. I found a similar account of molybdic acid in Miller's Chemistry to that above given, and going further back (to Brande,) that Scheele, the discoverer of the metal, had employed the bisulphide (*molybdenite*) in his experiments. It then struck me that the SO_3—supposed to be eliminated—had perhaps combined with ammonia and the oxide of molybdenum to form the "molybdenate" of that alkali, and Mr. Charles and I tested the salt so called in the laboratory here, which we found to give a strong sulphur reaction on silver foil, and with barium. I think therefore it would be worth while to re-investigate the properties of this metal.

The following vesicles last made by me, I have laid in a tray according to their chemical arrangement, recorded in the following manner after my system, and I quote them here that they may serve as a guide to intending observers, the results of whose labours I should be glad to see published in the CHEMICAL NEWS.

Vesicles made Feb. 8, 1868, in Borax.

GROUP I.

1. *Ammonium*, Chl., 9th,[*] L.N. (C. 2nd S.)[†] The two orms appeared almost simultaneously.
2. *Potassium*, caustic, 8th, N.U. (D.S.)
3. *Sodium*, carb., 8th, N.U. (C.)

GROUP II.

4. *Barium*, cl., 9th. D.N. (   ). Crystals not yet distinguishable by pocket lens.
5. *Calcium*, oxalate, 9th, N. (   ) Crystals not yet distinguishable by pocket lens.
6. *Magnesium*, carb. Vesicle not blown till 15th.
7. *Strontia*, carb. Vesicle not blown till 15th.

GROUP III.

8. *Alumina*, corundium. Vesicle not blown till 15th.
9. *Chromium*, oxide, 12th, D. (S. Fl.)
10. *Cobalt*, oxide, 10th, D.C., (D. Fl.) Crystals not distinguishable by *transmitted* light.
11. *Iron*, oxide, 10th. D. (D.Z. 2nd S.) A peculiar blue colour by *reflected* light.
12. *Manganese*, oxide, 10th D.C. (D.Z.) A peculiar blue colour by *reflected* light.
13. *Nickel*, oxide, 10th, L.N. (D.) Appears to deliquesce slightly.
14. *Zinc*, carb., 10th, D. (D.S.)

GROUP IV.

15. *Arsenic*, oxide, 12th, D. (Gr.) Appears to deliquesce slightly.
16. *Antimony*, oxide. Vesicle not blown till 15th.
17. *Bismuth*, oxide, 10th, L.N. (D. Fl., 2nd S.)
18. *Cadmium*, oxide, 11th, D. (Fl.)
19. *Copper*, oxide, 10th, L.N. (Fl., 2nd D.Z.C_2.[‡] The first form of crystals transparent—a very unusual thing.
20. *Gold*. No vesicle formed.
21. *Lead*, oxide, 10th, D. (D.Z.Ci.)[‡]
22. *Mercury*,[‡] oxide, 10th, D. $\left(\frac{\text{D.S.}}{\text{Fl.}}\right)$
23. *Platinum*, chlor., 10th, D. $\left(\frac{\text{G.}}{\text{Fl.}}\right)$
24. *Silver*, oxide, 12th, D.N. (S.) The crystals in myriads a little larger than those of barium, are distinguishable as the small stars of astronomical nebulæ. The colouring matter round the wire ring is opaline with pink transmitted like the noble opal.
25. *Tin*, oxide, 12th, D. (S.) Crystal stars very few and far between up to date.

Non-Metals.

26. *Silicon*, SiO_2, crystallised after three weeks, D. (De.)
27. *Boron*, sassoline, D.U. $\left(\frac{\text{G.}}{\text{S.}}\right)$ Both forms of crystals transparent.
28. *Sulphur*. Vesicle not blown till 15th.

Although the crystallisation of these vesicles has naturally first and most occupied my attention, I have not by any means given up the idea (of examining their optical peculiarities) with which they were originally made. Although I have not an apparatus for observing them in polarised light, without which it is impossible to draw many valuable conclusions from their diffractive phenomena, I could easily see in forming the vesicles enumerated above, that the light was refracted much more by some than by others, and indeed Dollond's discovery of achromatism was based upon this principle. I found that *tin* and *silver* were almost the only two oxides which yielded a perfectly diaphanous non-refracting glass. *Lead, arsenic*, and *bismuth* were highly refractive, and *sulphur* even more so than these. *Chromium* also appeared to give a clear glass where blown out, but its colouring qualities would of course prevent any useful application of it to glass in this way.

Wishing to ascertain, as I had before observed the development of electricity in vesicles, if metals in this condition assume the electro-positive or negative state, and if this state affects their crystallisation, I blew a vesicle of *zinc* at one end of a piece of platinum wire, and one of *copper* at the other. To the ends of another piece of wire I affixed similarly a vesicle of *iron* and one of *tin*. In the first, the *zinc* crystals appeared within a few hours, of the *campanulate* order, very perfect, and very considerably larger than those of the single *zinc* vesicle; while the connected copper vesicle had comparatively few crystals, and so small that I cannot distinguish their shape. Similarly, in the *tin* and *iron* series, the *tin* crystals appeared disproportionately enlarged at the expense of the *iron* ones, and neither of them bore much resemblance to the typical crystals of single vesicles. If, then, the voltaic current is actually induced between couples of vesicles under crystallisation, it would appear to be in the reverse direction to that passing between the electrified metals, so that copper in this case becomes electro-positive to zinc. Iron to tin.

I have omitted to mention that different metals produce primary crystals of different magnitudes, to express which the Greek letters α, β, &c., might be used.

Woolwich, 15th February, 1868.

[Since the above was written, I have received (on the 17th February) what I cannot but consider as a confirmation of the hypothesis here advanced. I argued that crystallisations formed from *liquids*, as acid solutions, &c., are of the isomorphous (or secondary) form, because they occupy more time in formation, *i.e.*, aggregation of the primary forms, whereas the germs of crystals formed from fusion by fire, must be produced almost instantaneously on cooling, their growth afterwards being the only matter in which *time* is concerned. To prove this, therefore, I plunged a hot borax vesicle (in which unfortunately I had taken up some oxide of *antimony*) into a tumbler of cold water. There was no apparent change at first, and I laid the vesicle on cotton in the usual way. The same evening, I was delighted to find, on examining it with the microscope, indubitable forms of isomorphous crystals—tetrahedra with bevelled edges, hexagonal planes, and a most remarkable combination of the two crystallographical systems in the shape of a flower like a convolvulus, whose petals were formed of the ends of *prisms*. The *rationale* of the experiment seems to be as follows:—The pyrogenous crystallisation is checked by the plunge into cold water, and the borax being soluble, a liquid crystallisation is commenced. Snow crystals being (although formed from a liquid) of the primary form, would appear to be due to the rapidity with which they are frozen.]

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[*] Date of crystallisation.

[†] When there are two distinct forms of crystalisation, the *second* in time will be shown by a "2nd" prefixed. When the form gradually assumes a second shape, the ulterior will be placed *under* the first as in mercury.

[‡] *Discoisocilliate.* Compound terms of this kind can be used conveniently.

ON THE
ESTIMATION OF SULPHUR IN COAL GAS.

By WM. VALENTIN, Esq.,
Assistant in the Royal College of Chemistry.

Sulphur is known to exist in coal gas in several forms of combination, the principal of which is bisulphide of carbon (CS_2). By the combustion of gas for domestic purposes a certain amount of sulphurous acid is formed, which diffuses itself into the atmosphere of our rooms, together with the steam which is simultaneously generated, and becomes rapidly converted into sulphuric acid by the absorption of oxygen from the air.

Advantage has been taken of this oxidation of sulphur into sulphur acids by combustion, and methods of quantitative analysis have been based upon it. The best known, and I believe the most generally employed method for the quantitative estimation of sulphur in coal gas is that devised by Dr. Letheby, and which was described in the Chemical News of Feb. 14, 1863.

In my capacity of gas examiner to one of the London gas companies I have had frequent occasion to observe that this method of Dr. Letheby's, which recommends itself, at first sight, by its great simplicity and facility of execution, does not comply with the requirements of a *quantitative* test for sulphur in coal gas, for the simple reason that it never tells, even approximately, *how much* sulphur there really is in gas.

This arises from two causes—viz., imperfect combustion, and consequently imperfect oxidation of the sulphur compounds contained in coal gas; and, secondly, imperfect condensation of the sulphur products of combustion.

Whilst endeavouring to overcome these defects in Dr. Letheby's sulphur test, I first tried various burners that promised to consume the gas and to oxidise the sulphur compounds more perfectly; but I found that I made but little progress, and sometimes obtained even a lesser per centage of sulphur than that given by Dr. Letheby's apparatus. I was more successful in preventing a loss of sulphur arising from incomplete condensation. This loss was, however, not so great as to account for the deficiency in the sulphur indicated by Dr. Letheby's test and that given by more perfect methods, such as the soda-lime process.

Professor Anderson, of Birmingham, who bestowed much attention upon the method now generally employed for estimating sulphur in coal gas,* and who, it would appear, directed his efforts principally towards a more complete oxidation and absorption of the sulphurous products that pass off with the large amount of non-condensable gaseous products of combustion, sums up his results as follows:—

"1. That a single (fishtail) burner, consuming the gas at the rate of 2½ cubic feet in five to six hours, effects its combustion most completely; that even under these circumstances 2½ per cent of the sulphur in gas cannot be burned into sulphurous acid.

"2. That in no case can the sulphurous products of the combustion be wholly recovered where condensing receivers open to the external atmosphere are employed. The best arrangement of apparatus set up on this principle loses 40 per cent of sulphur, and the arrangement given by Dr. Letheby, I find, from the same cause, always entails a loss varying from three-fourths to four-fifths of the bisulphide sulphur in the gas."

At page 49, referring to the corroborative quantitative results obtained by M. Ellisen,† of the Paris Gas-Works, and by Mr. Evans, the engineer of the Chartered Gas-Works, Professor Anderson again states "that by the employment of the 'Leslie' jet and open receivers not more than from one-fourth to one-fifth of the bisulphide sulphur of coal gas can be estimated."

After failing in various attempts to convert the sulphur compounds entirely into sulphuretted hydrogen, by passing the gas together with steam over heated copper, &c., my endeavours were mainly directed to secure complete combustion of the gas, so as to obtain all the sulphur impurities in the form of sulphuric acid, and not as sulphurous acid, as I had observed how difficult, or rather how impossible, it is completely to oxidise a small quantity of sulphurous acid diffused throughout a large amount of gaseous products of combustion, and to absorb it by passing these products through various oxidising solutions.

There is, as is well understood, a definite amount of air required to completely burn coal gas, and to convert it into its two principal ultimate products of combustion—carbonic acid and water (steam). Sulphur compounds are oxidised readily into sulphurous acid; complete oxidation to sulphuric acid, however, is effected with much difficulty only, as will appear hereafter. It appeared to me, then, that a mode of combustion which supplied to the gas that amount of atmospheric oxygen which is requisite to cause complete combustion (or a slight excess of atmospheric air even), and which brought the gaseous particles into the most intimate contact with the oxygen of the air, at a high temperature, during their passage over a highly porous material, such as spongy platinum, known to possess that power in the highest degree, would most effectually accomplish the object in view.

On testing this theory by experiment, I found that complete combustion was effected by causing the gas to pass, together with an adequate amount of air, through a porcelain tube strongly heated in a small Hofmann's gas combustion furnace. Gas and air are mixed just before they enter the tube, and are made to pass slowly over ignited spongy platinum, loosely packed in a platinum cage made of a sheet of fine platinum gauze, which completely fills the tube. With an insufficient amount of air—about three parts of air to one of gas—carbonic oxide is mainly formed, and the sulphur in the gas is converted chiefly into sulphurous acid, part of which resolves itself into sulphuretted hydrogen on passing along with the steam over the ignited spongy platinum—

$$SO_2 + OH_2 = SH_2 + O_3$$

yielding, in fact, oxygen to aid in the combustion of the carbon compounds of the gas.

A vivid combustion takes place in the anterior portion of the tube, just where the mixture of gas and air first comes into contact with the spongy platinum. On passing the gaseous products of combustion through several Woolfe's bottles and towers containing powerful oxidising solutions, such as chlorate of potash and hydrochloric acid, and lastly through a solution of pure soda and through distilled water, I satisfied myself that it is extremely difficult to completely oxidise and absorb the sulphur product of the combustion, since I almost invariably found traces of sulphurous acid in the last tower containing distilled water only. It was evident that no reliance could be placed upon the oxidising and absorbing power of the various solutions. Gaseous sulphurous acid is not oxidised nor retained so readily, when mixed and diffused throughout an overwhelming amount of other gases, as is generally supposed, and it became, therefore, necessary to modify the mode of analysis at first adopted. This is a fact of great importance, since it throws light upon the discrepancies observed by various chemists in the results obtainable by Dr. Letheby's apparatus.

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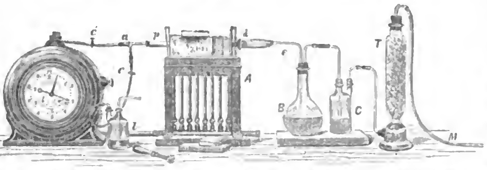
* "On Defects in the Apparatus generally used for the Determination of Bisulphide of Carbon in Coal Gas." A reprint from the *Journal of Gas Lighting*, p. 53.

† "Sulphur in Coal Gas." Report by Thos. G. Barlow, C.E., and Albert Ellissen, Chief of the Experimental Works of the Paris Gas Company.

After various alterations I fixed at last upon the apparatus represented in the following figure.



A is a small gas combustion furnace, containing three perforated clay burners in a row or line. Eight or ten rows of such burners suffice. On the low burners of the middle row rests a Berlin-ware porcelain tube, *p*, capable of resisting a high degree of heat and rapid changes of temperature. This porcelain tube, *e*, is 12 inches long, and has a diameter of half an inch. It is best embedded in thin layers of asbestos, spread out in a tinned iron trough, to prevent the direct action of the gas-flames upon it. A platinum tube, made of fine platinum gauze, is made to fit tightly into the porcelain tube. It need not be longer than from 5 to 6 inches. One end is closed by causing the platinum gauze to overlap, and the tube can then be filled with spongy platinum, and when closed at the other end and fastened together at short distances with thin platinum wire, is ready to be introduced into the porcelain tube A tight fitting cork fixes a narrow glass tube, *a*, drawn out to a point, into the anterior part of the porcelain tube. The latter reaches far enough out of the furnace, and the flow of cold gas and air mixed keeps this part of the tube sufficiently cool to render slight explosions in the anterior part of the porcelain tube and in the glass tube of rare occurrence, Although harmless enough in themselves, they may be entirely avoided by admitting a slight excess of air over that required to completely burn the gas. The gas is supplied through one leg of the short bifurcated tube, and the air through the other. Both gas and atmospheric air are measured by being passed through meters of sufficient capacity to register from 5 to 10 cubic feet of gas per hour. The air may be passed through a solution of acetate of lead, contained in a small two-necked Woolfe's bottle, *l*, to deprive it of any trace of sulphuretted hydrogen before it enters the meter. Compression cocks, *c c'*, regulate the flow of the gas and air.

Over the posterior end of the porcelain tube is fitted an adapter-tube, *d*, drawn out and joined on to a narrow glass tube, *e*. The narrow end of the tube is bent at right angles, and fits tightly into a perforated cork, so as to deliver the gaseous products of the combustion into a solution of pure caustic soda, made entirely free from sulphuric acid, by burning sodium under water, such as is obtained now in commerce from the Magnesium Company, Manchester. From 10 to 15 grammes are a convenient quantity to be employed. This solution of caustic soda may be placed into a two-necked Woolfe's bottle, or, as shown in the drawing, into a small flask, B, capable of holding about a pint of liquid, fitted with a doubly perforated cork. If sufficient caustic soda is present in the flask, the whole of the sulphuric acid—for such only is obtained when the combustion is properly conducted—is retained in the first liquid. The greater portion of the sulphuric acid is even found to condense in the adapter-tube, *d*, and may be washed out, and estimated separately.

From the flask containing the caustic soda the gaseous products may be passed through a second flask or through a two-necked Woolfe's bottle, containing a few grammes of chlorate of potash, and moderately dilute hydrochloric acid; and from this into a third, containing a little pure carbonate or caustic soda. Any trace of sulphurous acid is thus oxidised into sulphuric acid, and is retained in the various solutions. And, lastly, the gases are passed through a tubulated cylinder containing a column of a few inches of distilled water, and in its upper part large pieces of broken glass, offering a large moist surface to the gases, and from the top cork, through a bent tube, towards the aspirator M.

I find, however, that when the mixture of gas and air is properly adjusted, ***the whole of the sulphuric acid is retained in the first flask***, B, and that the Woolfe's bottles containing the oxidising solutions and the alkali may be entirely dispensed with, retaining for precaution's sake merely one Woolfe's bottle, C, containing a few grammes of pure soda solution, and the condensing-tower, T, as shown in the drawing.

It is, of course, out of the question to drive gases through a series of solutions offering a resistance of a couple of inches of water pressure, without the aid of an aspirator. When a plentiful water supply can be obtained, an aspirator may be used, constructed on the principle of the Catalonian water-blast, with a fall of water of from 8 to 10 feet. Another convenient aspirator, which, moreover, strongly recommends itself on account of its economical use of water (bulk for bulk of air, or nearly so), was devised, some short time ago, by my colleague, Mr. M'Leod, and is described in the *Journal of the Chemical Society*, March number, 1867, page 164.

Perhaps the most simple and convenient means of aspirating air consists in using a 5 or 10 cubic feet gasholder, employed exhaustively. When full the combustion may be temporarily interrupted, till the products of combustion have been discharged from it. Such gasholders are generally found in large gas works, and are used for testing gas meters. Thus any loss of water will be altogether obviated.

The flow of the gases is best regulated by means of a gas-tap, connected with the india-rubber tube leading to the aspirator from the condensing-tower.

The combustion must at all times be so regulated as to cause the products of combustion to pass off without showing a peculiar white smoke or cloudiness within the condensing-flasks. This is effected by having about ten times as much air as coal gas. It is quite possible to burn from 0·5 to 0·6 of a cubic foot of gas per hour, and, as only 2 or 3 cubic feet of gas have to be burnt to obtain a sufficient amount of sulphuric acid for a correct estimation, one is enabled to conduct and finish an estimation during a time of the day when the chief consumption of gas takes place—viz., in the evening.

The following tables contain the results of a series of experiments, conducted at the Laboratory of the College, upon ordinary coal gas supplied by the Chartered Gas Company:—

Table No. I.

Date of Experiment.		Cubic Feet of Gas burned during the Experiment.	Amount of Gas burned per Hour.	Sulphate of Barium obtained, in Grammes.	Sulphur per 100 Cubic Feet of Gas, in Grains.
April	16	2·3	0·48	·2822	23·98
	17	3·3	0·73	·4240	27·21
	18	3·2	0·71	·4680	30·95
	20	3·2	0·80	·418	27·92
	23	5·	1·10	·627	26·55
	24	3·2	0·96	·430	28·45
	27	5·8	0·93	·8375	30·58
	30	3·9	0·78	·632	34·33
May	15	3·7	0·85	·4623	26·58
	17	4·	0·89	·7283	38·56
	20	5·	0·79	·5967	25·27
	21	5·	0·94	·5806	24·59
		*4·5	1·00	·260	12·23
	22	5·	0·95	·5595	24·03
		*6·	0·90	·3902	13·78
	23	5·1	1·18	·6285	26·07
		*6·5	0·93	·501	16·32
	24	6·5	1·24	·683	24·19
		*7·75	0·97	·6545	17·91
	25	7·2	1·07	·875	25·75
	28	8·8	1·34	·975	23·48
		*6·5	0·93	·543	17·70
	29	4·1	0·75	·5365	28·73
June	27	2·75	0·42	·280	21·60
July	1	3·5	0·64	·5778	34·87
	2	3·5	0·58	·347	20·98
	3	4·5	0·66	·462	21·62
	4	3·25	0·65	·382	24·89
		*4·25	0·70	·2741	13·6

* This mark indicates the analysis made simultaneously by the Letheby apparatus.

Table No. II.

July	5	2·75	0·51	·2705	20·00
		†2·85	0·88	·3814	28·35
	6	3·	0·64	·334	23·50
		†3·02	1·00	·3818	26·79
	8	3·5	0·56	·4525	27·37
		†3·4	0·97	·5224	32·56
	9	†4·6	0·84	·6971	32·14
	10	3·	0·60	·3278	24·05
		†4·8	0·91	lost	—
	11	3·	0·50	·3457	24·32
		†5·1	0·98	·7770	32·25
	12	3·	0·53	·3585	25·32
		†5·	1·00	·7057	30·00
	13	1·5	0·52	·2203	31·09
		†2·65	0·93	·4252	33·95
Sept.	18	†5·0	0·83	·7422	31·46
	20	2·55	0·50	·353	29·34
		†4·5	0·90	·7167	33·74
	21	1·3	0·40	·1815	29·58

† This mark indicates the analysis made simultaneously by the soda-lime process.

On half-a-dozen occasions an experiment was carried on simultaneously with the apparatus devised by Dr. Letheby, and it will be seen that the results are considerably below those which were obtained at the same time by the new method; by far not so low, however, as Professor Anderson states the loss to be.

There can be little doubt that the so-called *lime process* is by far the most perfect method of estimating sulphur in coal gas which can be found. It consists in passing the gas over lime (best soda-lime) loosely packed in a combustion tube of hard glass, and heated strongly from the outside in a gas combustion furnace.

Unless, however, *pure* lime and *pure* soda (free from sulphuric acid) are used, little reliance can be placed upon the process. The glass, moreover, is acted upon to a disagreeable extent, silica being dissolved out; and unless the gas be sent through the tube at a very slow rate, much carbon is deposited. The sulphur products also require oxidation after being dissolved out, and it needs no little experience in chemical manipulation to steer clear of all these drawbacks to an otherwise excellent method.

In order to check the above results by those obtained with the soda-lime process, I prepared some perfectly pure soda-lime by calcining marble, and slacking the pure caustic lime so obtained with a solution of pure caustic soda, and I thus succeeded in getting a soda-lime which was perfectly free from sulphuric acid. In order to avoid the action of the alkalies upon the glass, I used a narrow-bore gun-barrel, coated over with fire-clay made into a stiff paste by means of starch solution, or solution of British gum, and dried, previous to being placed on the furnace. In this manner I succeeded in getting, to a great extent, over the above-described shortcomings of the method.

It will be seen from Table II. that the results obtained by the soda-lime process were invariably somewhat higher than those obtained by combustion of the gas over spongy platinum. I convinced myself that this arose from a slight loss of sulphuric acid, on account of its being retained by the spongy platinum, and condensed on the inside of that part of the porcelain tube nearest to the adapter-tube. It is, therefore, advisable to invariably wash out with distilled water both the porcelain tube and the cage of spongy platinum. The latter appears to retain the sulphuric acid with great pertinacity, and it requires repeated digestion with hot distilled water, slightly acidulated with hydrochloric acid, before the sulphuric acid can be dissolved out entirely. The cage of spongy platinum must be dried and ignited before it is put again into the dry porcelain tube.

If it were not for the difficulty and extreme tediousness with which the soda-lime process is attended, there can be little doubt that it would deserve the preference over any process known at present for estimating sulphur in coal gas.[*]

It has been my endeavour to provide the practical gas engineer with an apparatus for estimating the sulphur in gas which is easily manageable, and which requires but little supervision when once set going; also to obtain the sulphur at once in the shape of sulphuric acid without the aid of oxidising agents, such as nitric acid, bromine or chlorine water, chlorate of potash, and hydrochloric acid, solution of hypochlorites, &c. The soda solution contained in the flasks is simply rinsed out into a beaker. The adapter-tube, as well as the porcelain tube and spongy platinum, are carefully rinsed out with distilled water; the liquid is acidulated with hydrochloric acid, the whole heated to ebullition, and the sulphuric acid precipitated by means of chloride of barium as sulphate of barium. The precipitate is filtered off, washed, dried, and weighed in the usual manner.

Since writing these lines for publication in the *Journal of Gas Lighting*,[†] I have made further experiments with a view of combining the advantages of the combustion method by means of spongy platinum with those of the soda-lime process. By introducing a few grammes of pure soda-lime into a short platinum tube, about 4 inches in length, made of thin sheet platinum, and placing the tube so charged into the porcelain tube so as to cause the gas and air first to pass over the spongy platinum, and then over the ignited soda-lime, I succeeded in fixng the principal amount of the sulphuric acid produced by the combustion of the gas as sulphate of sodium and calcium. I have, as yet, not been able to fix and retain the whole of the sulphuric acid, within the porcelain tube, so as to dispense entirely with the solution of pure caustic soda in flask B., but have little doubt that by substituting a platinum tube for the porcelain tube, and by employing a somewhat larger amount of soda-lime packed directly into the platinum tube, so as not to give to the gaseous products of the combustion a chance of passing off between the porcelain tube and the small platinum tube, by means of which I now introduce the soda-lime into the porcelain tube, without being brought into contact with the alkaline absorbents, I shall succeed in retaining every trace of the sulphuric acid formed.

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[*] The results obtained by the lime process by M. Albert Ellissen, of the Paris Gas Works, and given on page 16 of the reports on the sulphur compounds present in coal gas, by Mr. Thomas G. Barlow, C.E., and M. A. Ellissen, differ so widely one from another that I am inclined to think there must be some error. I have always found the amount of sulphur obtainable by the soda-lime process, as well as by the combustion process described, to vary but little from day to day

[†] January 7th, 1868.

I subjoin a few results obtained by this modified process of combustion.

Date of Experiment.		Cubic Feet of Gas burned during the Experiment.		Amount of Gas burned per hour.		Sulphate of Barium obtained in Grammes.		Sulphur in 100 Cubic ft. of Gas in Grains.
January 28th	..	2	..	·36	..	·352	..	37·10
29th	..	3	..	·52	..	·474	..	33·42
31st	..	2·8	..	·50	..	·503	..	38·05
February 3rd	..	3·3	..	·55	..	·522	..	33·52

In the last experiment the sulphuric acid was estimated separately in the portion of liquid derived from the soda-lime, and the washings of the spongy platinum; it amounts to 29·39 grains, whilst the sulphuric acid collected in flask B., by means of solution of pure caustic soda, amounted to 4·128 grains or 14 per cent of the total sulphuric acid formed.

The advantage of merely having to dissolve out the alkali with dilute hydrochloric acid without having to remove the cage of spongy platinum, is quite obvious, and as the soda-lime is obtained perfectly free from carbon-particles or from sulphide of calcium or sodium, the solution can without any previous oxidation or filtration be precipitated directly with solution of chloride of barium.

I hope in a future communication to be able to give you the results of such modified combustion in a platinum tube.

It is obvious that the process of combustion over spongy platinum is applicable to other gaseous mixtures containing sulphur compounds, such as the volatile products, which escape during the process of incineration of various vegetable or animal matter, containing sulphur and phosphorus in combination with albuminoids, as well as in that of metallic sulphates and phosphates There is, at present, no process known by which the *volatile* sulphur and phosphorus in albuminoid substances, can be ascertained with anything like satisfaction, *independently* from the sulphur and phosphorus, which is determined in the ash. I have, before this, tried slow combustion of such organic bodies, *ex. gr.*, wheat, flour, coal, &c., &c., in a current of air or oxygen, passing the products of combustion into bromine water and pure alkali, and obtained results which lead me to think that our knowledge of the amounts of sulphur which is present in grains, for instance, is very imperfect, and that a reliable process for the estimation of the albuminoid sulphur and phosphorus, in contradistinction to the sulphur and phosphorus present as sulphates and phosphates, would be a great desideratum.

I hope shortly to be able to throw some light upon this important subject.

Determination of Nitric Acid.—C. Nöllner. In the manufacture of potassic nitrate from Chili saltpetre liquors are obtained in which from the presence of large quantities of foreign salts the estimation of nitric acid by any of the methods commonly employed is almost impossible. The author therefore proposes the following new method. About one gramme of the solution or salt to be tested is gently heated with a concentrated solution of ammonic sulphate; absolute alcohol is added, and thus all salts are precipitated with the exception of ammonic nitrate. The latter after filtration is precipitated with an alcoholic solution of potassic hydrate (free from silicic acid), and the potassic nitrate washed with alcohol, dried and weighed.—(*Zeitschr. Analyt. Chem.* vi. 375).

ON

HEAT AND COLD;

A COURSE OF

SIX LECTURES[*]

(*Adapted to a Juvenile auditory*),

DELIVERED AT

THE ROYAL INSTITUTION OF GREAT BRITAIN,

(*CHRISTMAS*, 1867—8),

BY

JOHN TYNDALL, Esq., LL.D., F.R.S.

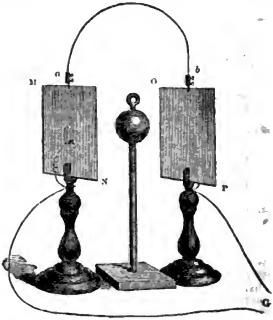
LECTURE V.

(Continued from page 79.)

Radiant heat.—Reflection and absorption of radiant heat.

You see I have here two sheets of tin, M. N. and O. P., one covered with lamp-black, and the other uncovered. I place them facing each other, and I put this stand exactly midway between them. Now, I have a little device here—a tell-tale—which will inform me which of these plates is heated. Suppose I heat this plate. Observe what occurs at the magnetic needle. I simply warm that plate by putting my finger upon it. The red end of the needle moves towards me. I cannot explain the wonderful power which moves the needle. It is what we call an electric current, and is produced by the union of the two metals of the thermo-electric pile. When the plate is heated you see that a deflection of the needle is produced. The needle will return to zero when I withdraw my hand. I want you now to judge which of these two surfaces absorbs radiant heat most freely. The needle will not rest at zero unless these two plates are exactly at the same temperature. If one becomes warmer than the other the needle will deviate from zero. Thus we have it in our power to determine which plate absorbs heat most greedily. Now Mr. Cottrell will give me a ball of copper which is heated to redness. You observe it is radiating its heat as a luminous body radiates light. [The red hot copper ball was placed equidistant between the two plates of tin, one of which was coated with lamp-black. In a few seconds the needle

FIG. 2.



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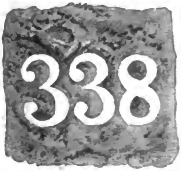
[*] Reported verbatim, by permission of the Author, for this Journal.

of the pole began to travel from the zero.] Thus we prove that this surface coated with lamp-black, which is the best radiator, is also the best absorber. We might experiment with a variety of substances in this way, and prove that great differences exist as regards their absorptive powers.

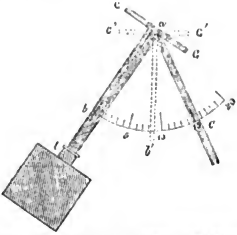
It is very wonderful what a slight and trivial thing will be sufficient to prevent the absorption of radiant heat. I have here an exceedingly instructive substance. It is a piece of paint given me by Mr. Hills, of the firm of Bell and Co. A portion of this paint is coated with gold leaf, and though the gold leaf is infinitesimally thin, it has been competent to protect the surface of the paint from the action of radiant heat to which the whole thing was exposed, while the other part of the surface, which was not covered with gold leaf, has become blistered. Where the gold leaf was present it prevented the rapid absorption of the heat.

Fig. 3.



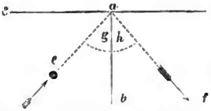
I have here a sheet of paper covered on one side with iodide of mercury, a substance which has its colour discharged by heat. On the other side of the paper there are certain figures represented by a thin coating of metal. I place the paper with the iodide of mercury side downwards; and over the other side I will hold a hot spatula which will radiate heat to the surface of the paper. Where the thin coating of metal is, the heat will be rejected, but where the paper is not coated the heat will be absorbed, and then it will reach the iodide of mercury on the other side and destroy its colour. You will find that in this way we shall produce on the underside of the paper a perfect picture of the figures on the upper side, for you will find that the red colour of the iodide of mercury will remain underneath the metal coating, for that coating has the power of rejecting the heat as the gold leaf rejected the heat in the other case, and so protected the paint and prevented its blistering. [The experiment was performed with a successful result.]

Fig. 4.



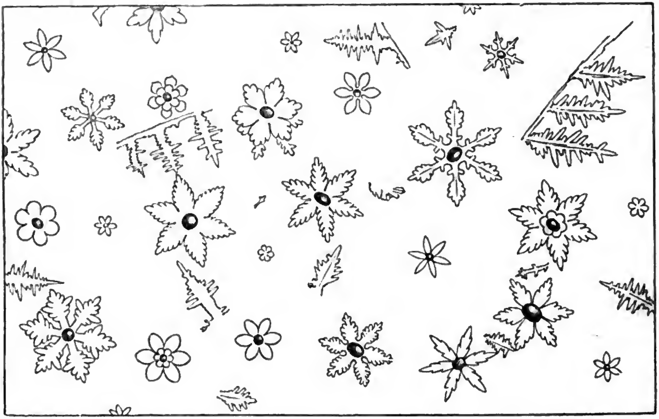
The radiation of heat obeys the same laws as the radiation of light, and it obeys the law of reflection due to light. This we can illustrate by means of our beautiful thermo-electric pile; but I will first of all make a single experiment that shall impress upon our minds the law according to which light is reflected. It is a very simple experiment, but I trust it will be very effective as far as regards the proof of the law. Mr. Cottrell, who knows my requirements very well, is now placing there in front a little looking glass, G G. I intend to send a beam of light, *a b*, from the electric lamp, *l*, towards the mirror G G. The beam will strike upon the mirror, and be reflected. How? So that the reflected beam will lie as much on the left of this index, *a b*, which is perpendicular to the mirror, as the direct beam lies upon the right side of it. There are two terms employed in connection with this subject which the elder boys ought to remember. This angle, *g*, made between the perpendicular, *a b* (Fig. 5), and the line, *e a*, along which the direct ray goes to the mirror, is called the *angle of incidence*. The angle, *h*, between the perpendicular *a b*, and the reflected ray, *a f*, is called the *angle of reflection*; and the law as regards both light and heat is this—that "the angle of incidence is equal to the angle of reflection." If I am right in what I have stated you will find the reflected beam as far from the perpendicular on one side as the direct beam is from the perpendicular on the other side. I want now to prove the same with regard to radiant heat by a very rough experiment, and show you that it obeys the same law as light. I take this piece of tin, which will reflect heat, and hold it so that the radiant heat from this fire will fall upon it, and then be reflected, according to the law I have just mentioned, on to the face of the pile. I have no doubt that reflected heat will warm the face of the pile, and cause the needle to move towards me. We thus see that heat exhibits the same law in this respect as light.

Fig. 5.



I wanted to make one or two experiments more, and I wished to do so, as before, by means of our thermo-electric pile; but I find that the needle does not act freely although the pile does its duty. Hence I think I must tell you by my tongue what that needle, if it were in a proper condition, would have told you by its motion. I intended to make the needle my voice, but it has become dumb. I wanted to show you that this thing we call radiant heat passes in very different degrees through different bodies. I wanted first to compare the passage of heat through glass with its passage through other bodies. I have here a piece of rough glass, and I have also a beautiful substance—a very common one, but to me more precious than the diamond, though the diamond is a beautiful thing. This substance is rock salt. This would allow heat to pass through it with perfect freedom, while the glass would cut it off. So with different liquids. I have here a liquid called bisulphide of carbon, and here I have some of the well known liquid called water. If I filled one cell with water and another with bisulphide of carbon, I should find that the bisulphide of carbon would transmit heat with great freedom, while the water would not transmit it at all. Water is, indeed, as regards heat, one of the most opaque bodies in nature to all but incandescent or luminous heat. It is a perfectly opaque body to all rays emitted, say from the surface of a boiling kettle, or from the heated cube, or from the cheek of the young philosopher who helped me in an experiment in the early part of this lecture. During the burning of Her Majesty's Theatre the heat struck upon the windows of a club house opposite, and as the glass would not allow the heat to pass through, the windows became hot, and thus the glass was broken. Had

Fig. 6.



those windows been composed of rock salt the heat would have passed through them, and they would have remained perfectly cool, although there might have been an efflux of the most powerful radiant heat. If time allows, I will show you in the next lecture that we can boil water by radiant heat passing through bisulphide of carbon, though the same heat does not boil the bisulphide of carbon through which it is transmitted, notwithstanding that bisulphide of carbon boils at a lower temperature than water.

I have told you that different bodies, both solid and liquid, possess the power of transmitting heat in different degrees. Now, the body which absorbs the radiant heat, instead of transmitting it, becomes warm by the absorption. Ice is a body which is exceedingly opaque to the rays of heat, but allows light to pass through with freedom. I intend to place a piece of ice in the path of a beam from the electric lamp, and which will be a mixed ray of heat and light. The ice will stop by far the greater portion of the radiant heat, and the heat will be lodged within the ice. But the temperature of ice cannot be raised beyond 32° Fahrenheit without the ice beginning to melt, so that the portion of the beam arrested by the ice will occupy itself in liquefying the interior of the ice. It will liquefy the ice internally, and I want you to see the wonder and the beauty involved in this beautiful substance which you skate over every winter, but, perhaps, never think of. This beam of light and heat passing into the ice will dissect the ice and separate the crystals, and you will see the beautiful figures into which the ice resolves itself. The ice will break up internally into most beautiful flowers consisting of six petals. In order to enable you to see these figures I must magnify them very much, and for that purpose I shall cause an image of them to be thrown on this large white screen. The lamp is placed in the gallery to increase the distance from the screen, and so make the figures appear larger. Mr. Cottrell has a lens there, and he will now take a piece of ice, and make the surface smooth by putting it on a warm body, and then place it in the path of the beam. The ice has been cut parallel to the plane of freezing from a block of the so-called Wenham Lake ice. It has been cut, I say, parallel to the surface along which the ice grows. [After a short time the image of the ice-flowers began to appear on thes creen.] I do not know any experiment that I have ever made which is more delicate and beautiful than this. The flowers are growing larger and larger. First of all you see these leaves, and within you see a crimping. Those spaces which you see are spaces entirely devoid of air, for you know that the water occupies less space than the ice. The ice is larger than the water which formed it, and as the inner portions of this piece of ice melt, the water occupies less space than the ice, and a small vacuum is produced at that spot. This screen presents a glorious surface of ice-flowers. Every particle of ice is built up in this beautiful way. The ice has now become disintegrated, but I do not think your patience has been ill rewarded.

Detection of Aniline in presence of Toluidine.—A. Rosenstiehl. Chloride of lime produces a blue colour with aniline, and a brown one with toluidine, but a mixture of the two only shows the latter reaction. If, however, ether is added the brown substance is taken up by the latter, and the blue colour of the aqueous solution becomes visible. The test as proposed by the author therefore is: Dissolve the base in ether, add an equal volume of water, then, drop by drop, a solution of chloride of lime, shake, and observe the colour of the aqueous layer.—(*Zeitschr. Analyt. Chem.* vi. 357.)

Analysis of Silicates.—R. Hofmann. Silicates in which the alkaline metals are to be determined and which are not decomposed by acids, may be brought into solution by the combined action of ammonic fluoride and sulphuric acid. The finely powdered mineral is mixed with three or four times its weight of the fluoride, moistened with sulphuric acid, and the whole gently heated on the water-bath, finally over a flame to expel excess of sulphuric acid. The dry residue is dissolved in chlorhydric acid, and proceeded with as usual.—(*Zeitschr. Analyt. Chem.* vi. 366).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 6th.

Dr. Warren de la Rue, F.R.S., &c., President, in the Chair.

In continuation of our report of this meeting we have now to give an account of Dr. W. J. Russell's lecture, "*On Gas Analysis.*" The apparatus in its modified form as now employed by Drs. Wililamson and Russell, was exhibited in the meeting room. It consisted of a wooden table on which was mounted a cast-iron mercurial trough of simpler form than that formerly described by Dr. Russell, and figured in the Chemical News, vol. ix. p. 282. The "laboratory tube," or vessel C, is dispensed with, and all the absorptions are conducted in the same tube as that in which the gases are afterwards measured. The pressure tube A, containing a standard volume of air, is retained, and all measurements are observed at uniform temperatures and at the same level. Dr. Russell described a handy little contrivance which enabled him to introduce potash and other reagents into the gas tube without admitting air or interfering with the volume of gas. This little instrument consists of an iron or steel wire, No. 9 or 10, passed through a crooked piece of glass tube and having one extremity roughened for the purpose of enabling it to hold firmly a tuft of moistened cotton wool. The glass tube ¼ inch in diameter being used as a director, the wire is pushed forward, underneath the mercury, until the cotton tuft rises above the level of the quicksilver in the absorption tube. By kneading the cotton wool in water, every trace of air could be expelled, and then the water could be displaced by potash or other solution; a little grease applied lubricated the passage of the wire through the glass tube. A number of analytical details were then given in proof of the accuracy with which a number of operations of this kind could be conducted without sensible alteration of the volume of gas. Carbonic acid introduced and then absorbed by potash (one part of saturated aqueous solution of hydrate of potassium mixed with two parts of water), caused no error, and five parts of such solution absorbed about 80 of carbonic acid. Oxygen could be easily removed by the same alkali, into which a few drops of pyrogallic acid was passed up. Olefiant gas and other hydrocarbons must be attacked by Bunsen's coke-balls, since the strong sulphuric acid would destroy the cotton; the lecturer thought, however, that gun-cotton might be used. In coal gas analysis this apparatus worked exceedingly well, and for hydrogen and other eudiometrical purposes the method of explosion was resorted to in a supplementary wooden trough, to which the eudiometer was transferred in a suitable transfer-spoon. The spindles and catgut adjustments of the old apparatus were retained, and likewise the mode of illumination and the sliding support for the telescope. Alterations of the level of mercury could either be effected by pouring in the liquid metal, or a stout glass tube sliding through a caoutchouc collar could be depressed into the cistern.

The **President**, in moving a vote of thanks to Dr. Russell, took occasion to notice the ingenious character of the contrivances made use of in several parts of the apparatus.

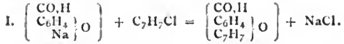
Dr. **Frankland** spoke in approval of the whole apparatus, and inquired whether the lecturer had constructed and used a reduced model.

Professor **Wanklyn** found that a piece of india-rubber tube used as a casing, overcame the objection of fragility usually ascribed to Frankland and Ward's apparatus.

Mr. **Maxwell Lyte** asked whether the use of soda instead of potassa was admissible?

Dr. **Russell** said that the efflorescent character of this alkali and all its salts was objectionable, as tending to soil the tubes. In reply to Dr. Frankland, he would simply affirm that very small volumes of gas could be manipulated in the present apparatus, since by raising the tubes high above the level of the mercury in the cistern the volume of gas might be read off when greatly expanded.

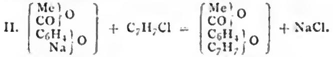
A paper "*On some New Benzylic Derivatives of the Salicyl Series,*" by Mr. W. H. Perkin, F.R.S., was then read by the Secretary. The author had examined the actions of chloride of benzyl upon the hydride of sodium-salicyl and gaultherate of sodium (sodium salicylate of methyl), respectively, and succeeded in obtaining bodies representing the salicylic aldehyde and acid, in which the phenolic hydrogen is replaced by benzyl. These new products have been named the *hydride of benzyl-salicyl*, and the true *benzyl-salicylic acid*. Combustions of these substances were made, and the ammonium, silver, mercury, lead, and copper salts of the latter were prepared and analysed. Their formation was thus explained—



$$\text{I.}\quad \left\{\begin{array}{l} CO,H \\ \left.\begin{array}{l} C_6H_4 \\ Na \end{array}\right\} O \end{array}\right\} + C_7H_7Cl = \left\{\begin{array}{l} CO,H \\ \left.\begin{array}{l} C_6H_4 \\ C_7H_7 \end{array}\right\} O \end{array}\right\} + NaCl.$$

Hydride of sodium-salicyl. Hydride of benzyl-salicyl.

The hydride of benzyl-salicyl is a colourless viscid oil having an odour like that of cloves, and boiling at a point above the range of the mercurial thermometer. It is possessed of aldehydic properties, although combining slowly with alkaline bisulphites.

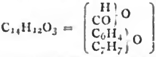


$$\text{II.}\quad \left\{\begin{array}{l} \left.\begin{array}{l} Me \\ CO \end{array}\right\} O \\ \left.\begin{array}{l} C_6H_4 \\ Na \end{array}\right\} O \end{array}\right\} + C_7H_7Cl = \left\{\begin{array}{l} \left.\begin{array}{l} Me \\ CO \end{array}\right\} O \\ \left.\begin{array}{l} C_6H_4 \\ C_7H_7 \end{array}\right\} O \end{array}\right\} + NaCl.$$

Sodium-salicylate of methyl. Benzyl-salicylate of methyl.

The benzyl-salicylate of methyl was then decomposed by boiling with alcoholic hydrate of potassium, when wood-spirit was evolved; and the potassium-salt in aqueous solution, then treated with hydrochloric acid, furnished the new acid in the form of an oil which slowly solidified to a mass of minute plates. Its fusion point is 75° C.

Benzyl-salicylic acid has the following composition—



$$C_{14}H_{12}O_3 = \left\{\begin{array}{l} \left.\begin{array}{l} H \\ CO \end{array}\right\} O \\ \left.\begin{array}{l} C_6H_4 \\ C_7H_7 \end{array}\right\} O \end{array}\right\}$$

A vote of thanks having been passed both to Dr. Russell and to Mr. Perkin the meeting was adjourned as already reported.

FOREIGN SCIENCE.

Paris, Feb. 18, 1868.

Essays for the Prize of the Société de Pharmacie.—Detection of Kreatinine in Urine.—Manufacture of Pyrogallic Acid.—Academy of Sciences: Propagation of Waves through Gaseous Media. —Manufacture of Charcoal, and Metallurgy of Iron.—Dialysis of Induction Currents.—Beet-root Fermentations.

Every year the Société de Pharmacie offers a prize for the best essay upon some subject connected with pharmacy. This year the announcement of the examiners' decision was enhanced in interest by a speech from M. Coulier, (reporter of the examining commission), in which he reviewed the work of the candidates. The detection of arsenic in cases of poisoning was the subject of an essay by one of the competitors, M. Aly-Read. The author had made experiments to determine exactly the temperature at which sulphide of arsenic is decomposed by sulphuric acid. Another competitor, M. Barret, chose for his subject a study of the preparations of opium described in the Codex of 1866. He sought to determine the causes which influence the proportions of morphine contained in different varieties of opium. Methods were given by which the amounts of morphine and narcotine might be estimated. The study of arsenic formed the basis of an essay from M. Dupuy. The first part related to the history of this element, taken first in a purely chemical aspect, then as a toxic agent. The second part contained the results of experiments upon the absorption and elimination of arsenical compounds. M. Dupuy states that an ordinary bath containing an amount of arseniate of soda up to 20 grammes will not affect a man. M. Eberlin sent an essay devoted to the chemical study of glycerine and its pharmaceutical applications.

Officinal cantharides was the title of an essay in four chapters, by M. Fumouze, (1) Natural history of cantharides; (2) Chemical history of cantharides; (3) Causes which can alter or enfeeble its properties; (4) Insects and acarides met with in cantharides.

The resins employed in pharmacy was the subject of an essay by M. Guelliot. Finally, M. Guichard, a competitor, sent an essay on the alkaloids of the cinchonas. A resumé of the actual state of science regarding the constitution of artificial alkaloids, and of the genus of natural alkaloids, opens the subject. Then there is a chapter in which the question is treated historically, followed by six others upon those alkaloids which are obtained from the cinchonas besides quinine, and the chlorinated, brominated, iodinated derivatives. These chapters contain a complete history of the chemical properties of these substances. The salts of quinine, cinchonine, and quinidine are treated separately. After these the extraction of the alkaloids, and their commercial preparation, form the subject of consideration, and then the adulterations of quinine are taken. M. Guichard devotes a chapter to the special study of the red colouring matter which forms when cinchonine, quinine, and especially quinidine, are submitted to distillation; pure quinine he finds does not furnish these purple vapours, the presence of a glucoside is necessary. The commission unanimously awarded the prize to M. Guichard.

M. Roussin has proposed the use of bichloride of mercury for the detection of kreatinine in urine; kreatinine is precipitated from its solutions by the mercurial salt.

MM. de Luynes and Esperandieu have published a research on the preparation and some properties of pyrogallic acid. They remark in commencing, that the processes actually in use yield only about 25 per cent of the weight of gallic acid employed. By the action of water at 200—210 degrees they are enabled to transform gallic acid into pyrogallic acid and carbonic acid. The process is conducted as follows:—Into a brass cauldron with a tightly fitting cover, the gallic acid is introduced with two or three times its weight of water; the cauldron is heated to 200—210 degrees, and maintained at this temperature for an hour and half to two hours. At the end of this time the vessel contains a slightly coloured solution of pyrogallic acid. By boiling with animal black the colour is removed; the solution is filtered, and the water removed by evaporation. Upon cooling the pyrogallic acid solidifies in the form of a hard crystalline mass, slightly amber, and sometimes rose coloured. To obtain the product white, it suffices to distil in vacuo; an operation which goes on very rapidly, almost instantaneously. The yield of pyrogallic acid obtained by this process is equal to the amount theoretically obtainable. These are the properties of pyrogallic acid described. A solution of pyrogallic acid added to lime-water, gives rise to a magnificent violent colouration. Ethylamine causes the same colouration. A concentrated slightly acid solution of quinine, added to a concentrated aqueous solution of pyrogallic acid, produces a yellowish crystalline deposit, which contains the elements of sulphate of quinine and pyrogallic acid. If perfectly pure filtered solutions are mixed, no precipitate is formed until a little crystal of sulphate of quinine is added; in which case the solution becomes immediately a solid mass. Orcine and resorcine react just in the same way with sulphate of quinine, whence this reaction with sulphate of quinine would appear to be common to those substances designated as phenols.

The memoirs brought before the Academy of Sciences on the 3rd of chemical interest were the following. On the rapidity of the propagation of waves through gaseous media, by M. Regnault. On the carbonisation of wood, and the metallurgy of iron by M. Gillot. On the decomposition of nitrates during fermentation by M. Schlœsing.

M. Bouchotte sent a third note on the dialysis of induction currents.

M. Gillot states in the first part of his memoir, that the only condition necessary for a good carbonisation of wood to take place, is that the operation be made to proceed slowly. The decomposition of the wood commences at about 100°, wherefore analyses of samples of wood dried at 150°, do not give the true composition. During the decomposition of the wood, resulting in production of carbonic acid, and hydrocarbons, heat is developed in the interior vessel, which is thus raised to a temperatnre in excess of that of the oven. This result is produced when the temperature of the oven approaches 300°, and it must continue to the end of the operation. Too rapid an increase of this internal heat gives rise to the formation of tar and gaseous products in unnecessarily large quantity, diminishing in a corresponding degree the useful accessory products, as well as the yield of charcoal. The condensed products are richest in acetic acid when the temperature of the oven is 218°; at this heat they contain 48 per cent. Wood, when the operation of carbonising is well carried out, may be made to yield 7 or 8 per cent of monohydrated acetic acid; finally, the resulting volume of carbon is two-thirds of that of the wood employed. The second part of this memoir relates to the employment of fuel in the furnaces used in the metallurgy of iron. M. Gillot says that it has been demonstrated that in operating in the ordinary way, with the blast furnace in general use, the calorific power of the combustible gases, escaping at the mouth, represents, with but slight variations, two-thirds of all the combustible matter employed. It has also been demonstrated that to convert the pig iron produced into steel or iron, the heat required is much less than the total heat which the combustible gases, lost at the furnace mouth, would produce by combustion. M. Gillot collects these gases by means of an exhauster, in a gasometer; he afterwards liberates them according to the requirements of the operation.

M. Schlœsing's note on the decomposition of nitrates during fermentation, referred to M. Reiset's memoir on beet-root juice fermentations. In answer to the request of the subscriber whose letter was forwarded to me, intimating that the subject of beet-root fermentation was one with regard to which details would be acceptable in England, an account of M. Reiset's research is introduced into this letter. The production of nitrous gas during the fermentation of the saccharine juice is regarded by the manufacturers as a serious accident. This result is, however, nearly always observed if the juice does not contain a sufficient quantity of free acid. Under these circumstances the fermentation is arrested, and usually it cannot be made to proceed again, no matter how much yeast is added. The lactic fermentation is developed, it predominates, and the sugar is rapidly converted into lactic acid. Juice which contains before the fermentation only two grammes of free acid, rapidly increases to eight or ten grammes the litre without any further addition of acid being made. M. Reiset has established by numerous experiments, that in a general way the juice resulting from the maceration ought to contain an amount of free acid equivalent to three grammes of monohydrated sulphuric acid in the litre. In well conducted distilleries it is customary to regulate methodically the proportions of sulphuric acid, too often used as a remedy for all accidents. The ammonia present in the beet-root juice, combined with feeble acids, is almost sufficient to completely saturate the sulphuric acid added during the operations. M. Reiset employs the method proposed by M. Boussingault to estimate the amount of ammonia: 30—50 c.c. of saccharine juice are distilled with a litre of pure distilled water, and 5 c.c. of solution of potash of 40 degrees, two fractions of 100 c.c. each are collected, and the ammonia deduced from the amount required to saturate a known volume of titrated sulphuric acid. The production of nitrous gas during fermentations has often been explained as due to a reduction of the nitrates found in the juice, but how then admit with the manufacturers that treatment with sulphuric acid prevents it? M. Reiset, thinking, on the contrary, the formation of nitrous gas to be attributable rather to oxidation of the ammonia when this alkali is not saturated by a powerful acid such as sulphuric acid, always keeps careful account of the amount of ammonia present in the beet-root, and regulates the employment of acid by the amount of this alkali. The idea has been put in practice in a distillery and has been at work three years; excellent results have been obtained, nitrous fermentations have happened only very rarely.

M. Schlœsing takes quite an opposite view with regard to the formation of nitrous gas in fermentations, and he advances experiments to prove that it is really a phenomenon of reduction. Experimenting with tobacco juice (naturally acid) to which he had added nitrates, he found that these latter remained intact until, owing to decomposition of the organic matter, the solution became alkaline, then they gradually diminished in amount. M. Schlœsing explains the nitrous gas as the effect of putrifying organic matters upon nitrates; he asks what there is astonishing in the bodies which are able to reduce sulphates to sulphides, being enabled to reduce nitrates to nitrites. The neutral or alkaline state he considers particularly favourable to the production of reducing matters, and therefore applies the fact observed by the alcohol makers, that addition of sulphuric acid prevents nitrous gas being formed, as a confirmation of his view.

CORRESPONDENCE.

THE RECENT DISCUSSION AT THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—In the report of the meeting of the Chemical Society, given in your last number, we observe that our speeches are rather inadequately given, and that inaccuracies have crept in. This is not to be wondered at, inasmuch as both of us read them rapidly from manuscript, which was afterwards (at the request of the President) handed to the Secretary for publication by the Chemical Society.

Our speeches contained matter which might have been appropriately given in answer to Dr. Frankland, who spoke later in the evening.

We wish now to make a few remarks on Dr. Frankland's speech as reported in your last number. We notice four examples of results obtained by taking what are there termed "artificial" waters, and operating on them by Dr. Frankland's method, and by our method. These "artificial waters" were prepared by treating water with peat, and were, therefore, waters containing unknown quantities of organic impurities, and consequently the want of coincidence between results got from them by the employment of the rival methods of analysis is in itself evidence of nothing beyond the fact that the methods give different results.

In Dr. Frankland's recent lecture, he gave four instances of the employment of his own method on another sort of "artificial" water, viz., on water of known composition. In these instances he dissolved known quantities of sugar, and in one case known quantities of sugar and chloride of ammonium in water, and so prepared waters containing known quantities of organic carbon and organic nitrogen.

In these cases—and these are the only published instances of a testing of Dr. Frankland's process—he had errors of about 3 cubic centimeters, 0.8 c.c. and 0.4 c.c. of carbonic acid, and in the nitrogenous instance he observed about 0·07 c.c. of nitrogen more than he had put into the water, and probably had committed an error of much greater magnitude.

As was said by one of us during the debate in the Society, errors of this magnitude are a satire on the claim to work to the 1-100th of a cubic centimeter, and hardly any severer censure could be passed on our method, which really does work to the 1-100th of a cubic centimeter, than for such a process as this of Dr. Frankland's to furnish results coincident or parallel with those given by it.

In reference to Dr. Frankland's experiments on the action of alkaline permanganate on some alkaloids, we have to remark that earlier in the evening one of us handed to the Secretary a short account of the action of this reagent on certain alkaloids, and on a variety of organic nitrogenous substances, and since the last meeting we have much extended these researches.

In your report, in giving Dr. Frankland's alkaloidal results, you give "Ammonia obtained." "By permanganates," "By combustion." In place of "by combustion," it should be "ammonia calculated from the formula." In point of fact, Dr. Frankland compared the ammonia equivalent to the total nitrogen of the alkaloid with the ammonia got from it by our process.

Dr. Frankland was unfortunate in his selection of strychnine, narcotine, and sulphate of quinine to exhibit want of *parallelism* between the ammonia given by our process, and the ammonia equivalent to the total nitrogen of the substance.

Dr. Frankland's numbers are:—

	"Albuminoid" NH_3	Total NH_3
Strychnine	·00032	·00101
Narcotine	·00031	·00068
Sulphate of Quinine ..	·00073	·00128

The real numbers, however, exhibit the "albuminoid" ammonia as exactly one-half of the ammonia which the total nitrogen could furnish. In place of ·00032 for strychnine, Dr. Frankland should have given ·00051.

At any rate, we have obtained from strychnine exactly one-half of its total nitrogen in the form of ammonia.

The total nitrogen got from strychnine, narcotine, and sulphate of quinine, and the "albuminoid" ammonia which their alkaloids yield, are quantities parallel to one another.

In conclusion, we have to remark that we do not remember to have heard Mr. Campbell make the admission of the possibility of error (owing to the possibility of there being ammonia in the distilled water used in his former experiments), which we find at the end of his speech as reported by you.—I am, &c.,

J. Alfred Wanklyn.
Ernest T. Chapman.

London Institution, February 17th, 1868.

MISCELLANEOUS.

Obituary.—Mr. W. Herapath, sen., who was well known as an analytical chemist, died on the 13th inst. at his residence, the Manor House, Old Park, Bristol. For some time he had suffered from diabetes, but till a few days previous to his decease he persevered in his professional pursuits. He was professor of chemistry and toxicology at the Bristol School of Medicine, of which institution he was one of the founders. The subject of this notice was the father of the well known analytical and toxicological chemist, Dr. W. Bird Herapath, F.R.S.

NOTES AND QUERIES.

Solvent for Essential Oils.—Can any of your able correspondents inform me of a solvent for the essential oils or the resinous essences, such as cinnamon or bergamotte, so as to enable me to mix them with water without creating a muddiness? Information upon the above will oblige a Subscriber.

Clarke's Process for Softening Water.—What quantity of lime, or lime water (assuming that 1 lb. of lime would dissolve in 90 gallons of water) would be required to precipitate the calcareous matter in spring water (by Clarke's process), the analysis of spring water being as follows: Per gallon in grains—carbonate of lime, 12·8, sulphate of lime, 1·5, chloride of sodium, 3·8, organic matter (vegetable), 2, hardness, 9°, ditto after boiling, 4° ?—Aquarius.

Determination of Free Sulphuric Acid in Superphosphates.—The following is a simple, and yet efficient plan: Estimate the sulphuric acid in the original sample by dissolving a weighed portion of the superphosphate in hydrochloric acid, not contaminated of course with any sulphuric acid, separate the insoluble matter by filtration, and after thorough washing with boiling distilled water, precipitate with chloride of barium, and let stand for some hours, separate the sulphate of baryta, and calculate the sulphuric acid from its weight. Now take another weighed portion of the superphosphate, ignite it gently, and proceed as just described; the difference of the two results as regards sulphuric acid obtained represents the free sulphuric acid in the sample.—Dr. A. A.

To Prevent Water Freezing.—Your correspondent "Volta" desires to know (1.) what proportion of salt has to be added to water to prevent it freezing when exposed to the coldest weather known in this country. I would advise "Volta" not to use salt, especially not when in contact with iron, but rather apply caustic soda, which dissolved in water does not affect iron, and at the same time if the solution is made strong enough will not freeze, while, as is well known, a solution of salt freezes, partly leaving a more concentrated saline mixture unfrozen. 20 parts by weight of caustic soda upon 100 parts of water are sufficient to keep water fluid even at as low a temperature as 10° F. As regards the use of alcohol, I think methylated spirits might do, a mixture of water and spirits of the specific gravity of 0·9760, *i.e.*, containing 20 per cent by volume of absolute alcohol will not congeal even at 8° F. A strong solution of commercial glycerine is very much used in the colder climes of Europe, *e.g.*, Russia, Poland, Sweden, to substitute water in wet gasmeters, as such a solution of glycerine does not freeze even in the cold weather, which is usually very severe in these countries in winter. During the winter from 1847 to 1848 at Stockholm, the temperature for several days was below the freezing point of mercury, that is,—40° F. During these days the late celebrated Berzelius made some experiments with frozen, *i.e.*, solid mercury, which could then be obtained readily in large quantity; this, in passing, and without reference to the non-freezing of the mixtures above alluded to at so low a temperature.—Dr. A. A.

TO CORRESPONDENTS.

W. Kirk.—In a short time.

J. Leasson, Glasgow.—We expect to receive the report in a few weeks.

W. B.—We will refer to the paper, and communicate particulars if they appear likely to be useful.

D. S.—Some Technological Dictionary would probably give you the required information. See "Ure's," "Brande's," "Cooley's," or "Watts's Dictionaries."

Jurors' Report of the Paris Exhibition, 1867.—We have had many applications for this report. On enquiry we find that no report of the Jurors is likely to be published in this country, and it is not known if such will be published in Paris.

Marshall Hall.—Dr. Roscoe has made the discovery of an ore of vanadium in the Alderly Edge copper ore, in Cheshire. This discovery formed the basis of the Bakerian Lecture, delivered before the Royal Society, by Dr. Roscoe. A report will shortly appear in our columns.

F. Blair.—The extract from the *Panama Star and Herald* is received with thanks. Professor Delisse's theory of the cause of earthquakes, however improbable it seems, appear to have been borne out by the accurate fulfilment of the predictions founded upon it. It requires careful attention before we could say whether this appeared a coincidence or not.

Communications have been received from Marshall Hall; G. Marrison, Tasmania; F. Blair; W. Thompson (with enclosure); G. Hain; W. Kirk; F. Foord, Victoria, Australia; W. Kellner; Captain W. A. Ross (with enclosure); A. L. E.; T. G. Barlow; Dr. T. L. Phipson (with enclosure); C. R. C. Tichborne; T. Hill; W. Venables (with enclosure); J. Samuelson; Dr. Adriani; J. Stephens; Dr. W. Bird Herapath, F.R.S. (with enclosures); S. Dowell; J. Taylor; M. L'Abbé Moigno; Philip Holland (with enclosure); Phillips and Co.; J. H. Atherton; T. M. Drown; F. Muspratt; Professor Pavesi; Negretti and Zambra; E. Leeds (with enclosure); M. Leoni and Co.; F. Suckling; W. Smith; J. B. Giles (with enclosure); R. Eaton; Marshall Hall.

Books Received.—"Reports of the United States Patent Office, 4 vols. for 1863 and 1864," from the Honourable the Commissioners of Patents. Stevens, Bros., Agents for Europe; "The Harrowgate Herald"; "Bristol Times and Mirror"; "Western Daily Press"; "Rollisson and Sons' Catalogue of Floricultural and Culinary Seeds"; "Journal of Gas Lighting"; "Darlington and Stockton Times"; "El Correo Hispano-Americano"; "Scientific American"; American Gas Light Journal"; "Zeitschrift Für Chemie, 4 parts."

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Bulletin de la Société Industrielle de Mulhouse.

October, 1867.

E. Kopp, "On the Preparation of Extracts of Garancine for Calico Printing."

November.

Rosenstiehl, "Report on the Methods used in Dieuze for Utilising Chlorine Residues and Soda Waste."

Journal des Fabricants de Papier.

October 15, 1867.

E. Bourdilliat, "On Testing the Materials and Chemical Products used in Paper Making. (Continuation.) Researches on the Mineral Substances contained in Paper. On the Detection of some Colouring Materials used in Paper Making. On the Determination of the Tenacity of Paper."

November 1.

E. Bourdilliat, "On Testing the Materials and Chemical Products used in Paper Making. Continuation. On some Changes which take place in Paper."

L'Invention.

October.

P. Alfraise, "On Raddisson's new Process for the Manufacture of Aniline Colours."

November.

C. Saix, "On the Natural Formation and Artificial Production of Diamonds."

Kunst und Gewerbeblatt.

August—September.

H. Le Play, "On the Use of Lime for Extracting Crystallisable Sugar from Saccharine Juices, Syrups, and from the Molasses of Beet and Cane Sugar." O. Desaga, "On the Use of an Infusion of Guaiacum Wood for Testing Kirschwasser." C. R. Von Hauer, "On an Alloy of Bismuth, Lead, Tin, and Cadmium fusible at a very Low Temperature."

Bulletin de la Société d'Encouragement.

September.

E. Peligot, "On some Processes now in Use for Engraving on Glass by means of Hydrofluoric Acid." De Luynes, "On a Method of Obtaining Colouring Matter from Orcine."

Comptes Rendus.

November 25.

E. Bourgoin, "On the Electrolysis of Organic Acids and of their Salts." A. Scheurer-Kestner, "Some Experiments on the Manufacture of Chloride of Lime." A. Gautiar, "On the Isomers of the Nitriles of the Fatty Series."

MEETINGS FOR THE WEEK.

Monday.—Geographical, 8½.
Tuesday.—Royal Institution, 3. Professor Tyndall, "On the Discoveries of Faraday."
Wednesday.—Society of Arts, 8.
— Geological, 8.
Thursday.—Royal Institution 3. Professor Tyndall, "On the Discoveries of Faraday."
— Royal, 8½.
— Zoological, 8½.
— Philosophical Club, 6.
Friday.—Royal Institution, 8. A. Vernon Harcourt, Esq., "On the time in which Chemical Actions take place."
Saturday.—Royal Institution, 3. Professor Roscoe, "On the Non-Metallic Elements."

CANDLES.—If you do not want your candles exclusively for show, but with pleasantness of appearance require excellence of burning, buy "Price's Gold Medal Palmitine," or their "Sherwood Palmitine," or their good old-fashioned "Belmont Sperm," or "Belmont Wax," or their "Best," No. 2," "No. 3," or "Battersea" Composite," in preference to the finest, and most transparent Paraffine candles. But if you must have the extreme transparency of pure Paraffine, "Price's Paraffine" or their "Belmontine" will give it to you in perfection, and at a more moderate price than is usually charged for any other really first-class Paraffine Candles.

The new toilet soap, "PRICE'S SOLIDIFIED GLYCERINE," containing half its weight of their concentrated distilled Glycerine, should be in general use in every house before the winter comes on, because of its admirable effects in preventing chapping of the hands and face. In every house there ought also to be one of the sealed bottles of their concentrated Distilled Glycerine, known everywhere as "Price's Glycerine," and prescribed by the most eminent medical men abroad as well as at home, as the one only Glycerine for medicinal use whether externally or internally.

PRICE'S FANCY SOAPS of the different sorts usually made are excellent, and command a constantly increasing sale. The "Solidified Glycerine" spoken of above is, however, the one fancy soap to use.

"PRICE'S NEW PATENT NIGHT LIGHTS," for burning in the wide glasses are believed to be the very best Night Lights made. "PRICE'S CHILDS' NIGHT LIGHTS," for burning without glasses, and their different sorts of "CHAMBER CANDLES" are so well-known, and so generally appreciated as not to need any special notice here.

THE CHEMICAL NEWS.

Vol. XVII. No. 430.

REMARKS ON THE VOLUMETRIC ESTIMATION OF PHOSPHORIC ACID.

By CHARLES F. BURNARD, F.C.S.

Having been for a considerable period engaged in the analyses of phosphatic substances, raw and manufactured, I send for insertion in the pages of the Chemical News, some of my experiences in the pursuit of the volumetric process. I have confined myself almost entirely to the use of nitrate of uranium in the well known manner, which need not here be described; but in the following of which, according to the published methods, several precautions are necessary; while often with the greatest care as to uniformity of volume in samples tested, it is frequently doubtful when the point of colouration is obtained. For (say) in two determinations of the same sample made side by side, it is seldom that complete uniformity of results are obtained. Much depends on the size of the drop falling into the little pool of ferrocyanide, something in the manner in which the said drop falls, while in all cases *time* is an essential element in the question. If testing be continued, as is usually directed, until the brown colouration is evident, the result will be far too high. To prove this, let the operator in reaching the desired indication, cover over his slab (to prevent drying) and leave it so some hours, say until next morning, when he will find the point to be five or six units below that indicated over night. But even now there is much uncertainty, for say he has (as he should always have) tried two side by side, he will frequently be perplexed in making his decision. I am happy, however, in being able to record a method by which all doubt is dissipated, and much greater accuracy obtained.

If the composition of the substance (say a manure) be quite unknown to me, then I make a preliminary examination, which soon shows the probable range of the per cent of its phosphoric acid. But in general this is unnecessary. I use a plain porcelain slab, pits or indentations for the pools being objectionable, as hindering due access of light to the body of the pool. To prevent flowing about, a ring of cork, giving a clear space of ¾ of an inch, pressed on some hard tallow and then on the slab, leaves a faint but effectual wall of grease.

My method may be best explained as follows, giving an actual determination by way of illustration. Three portions of the same solution, being each 100 septems, were taken and tried side by side on the same slab.

No. 1.—26	28	30	32	34	Septems.*
No. 2.—25	27	29	31	33	,,
No. 3.—24	25	26	27	28	,,

Now, at the conclusion of the actual testing, not one exhibited the slightest trace of brown colouration; they all appeared precisely alike. They were then covered over and left until the morning, when one only, viz. 34, showed the red brown colour, and that as an intense bright eye in the centre of the pool.

Now, following out my new plan, the slab was carefully put on a levelled stand before a fire, and the spots dried by radiant heat falling on their surfaces. Gently drying in this way being preferable to any other, for rising from below the heat disturbs the settlement of the precipitate. When dry, and the slab just warm, water was carefully dropped on each spot, so as to dissolve the dried-up ferrocyanide, when as if by magic, although on the dried slab there was not a trace of brown visible, the truth was revealed, and the reading became—

No. 1.—30 stood as the number
No. 2.—29 do. do.
No. 3.—29 do. do.

At the time of testing there was no exhibition of colour: next morning 34 stood revealed; but on drying and redissolving, as explained, 29 was unquestionably the number. It is obvious that while a precipitate may be so slight as to render the colouration of a small pool difficult, yet by its settling down on the white slab it is immediately revealed on dissolving away the crust covering it.

Side by side with the above, has been tried another volumetric process, of my own devising, at least new, so far as I am aware of. It is exceedingly simple, and has afforded satisfactory results. Of course it is not suitable in all cases, but may be applied to the determination of the phosphoric acid, in the great majority of the so-called superphosphates; its value being increased, moreover, by the fact that it necessarily involves the estimation of the free acid in the manure. Suppose a superphosphate made in the usual manner; in such a manure the bone phosphate may be measured by the quantity of sulphuric acid employed in its solution. I extract all that is soluble in water from 100 grains of the manure, and divide it into two equal volumes of one thousand septems each, in beakers of the same dimensions. Into one I drop a standard solution of soda from a burette, when, as is well known, a precipitation of bone phosphate occurs; this, however, on gently moving with a stirrer is re-dissolved; and I continue to drop in until there is a faint trace of a permanent precipitate, which may be the better detected by comparison with the other volume in the second beaker. When sufficient soda has been added, then after duly noting the number of septems employed, an additional septem may be dropped in, when a decided milkiness and agitation will be manifest. The number of septems thus employed is the measure of the free acid existing in the manure. A little practice will enable the operator to very nicely determine the point of incipient precipitation. I now throw in a piece of litmus paper, if blue it instantly becomes red, and then continue the soda dropping until the red litmus becomes nearly blue. A few minutes' repose will allow sufficient time for the precipitate to somewhat settle down, leaving a clear space above; into this a drop of soda solution may be carefully let down, when, if further precipitation occurs, more soda may be added, the whole stirred, and allowed again to subside. In practice it is found that the litmus should be brought to a decided but not to a deep blue. Now, the further volume of the standard soda solution employed, is the measure of the sulphuric acid economically employed in the manure, and is therefore the measure of the amount of the phosphoric acid in solution. In my own practice I have worked out a number, by which, on multiplying the number of septems of the standard solution of soda used, there is at once obtained the equivalent of the phosphoric acid in the shape of tribasic phosphate of lime. In comparative determinations, this process has given me results nearly constantly one half per cent too low.

Compton Gifford, February 24th, 1868.

* * *

Crystallisation by means of the Blowpipe.—G. Rose finds that the opaqueness which blowpipe-beads frequently assume on cooling is due to a separation of crystals. He prepares them for examination under the microscope either by flattening out the bead or by dissolving it in water. Titanic acid under such conditions forms anataes. If titanic acid is fused with microcosmic salt in a covered crucible, a blue glass is obtained in which crystals are enclosed, and if a small piece of this glass is now heated in the oxidising flame crystals are formed, differing from anatas in shape and optical properties. — *Mbed. z., Berlin*, 1867, 129.)

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* In the above each number is intended to represent a thin pool of ferrocyanide of potassium, of about ¾ inch diameter: and also in each case the number of septems of nitrate of uranium employed.

METHOD FOR THE

DETERMINATION OF SILICON IN IRON AND STEEL.[*]

By V. EGGERTZ,
Professor at the School of Mines, Fahlein, Sweden.

Everybody who has been engaged in the analysis of iron and steel is well aware how very uncertain the determination of silicon becomes when the method hitherto used for its separation in the form of silica is followed, because not only cast iron, but also bar iron and steel, is never found absolutely free from slag intermingled with it. This slag is decomposed by the ordinary method of dissolving the iron in acids, and its silica then augments the amount of silica formed from the silicon contained in the iron or steel; accordingly, too much silicon is obtained when the ordinary method has been employed, as nearly the whole of the silica remains unacted upon, a very small portion only going into solution.

The same thing cannot be said of certain sorts of cast iron, but these sometimes contain blast-furnace slag. In the collections of the Mining Institution at Fahlein are some specimens of spiegeleisen which evidently contain particles of slag; at the same time, pig iron containing slag may be considered as rare.

It ought also to be mentioned here, that, according to the *Berg. und Hüttenmannisch Jahrbuch*, vol. xi., page 289, crystallised silicon has been found in crystallised cast iron from Krain, in the form of small silvery plates, which were neither acted upon by boiling aqua regia nor by ignition in oxygen gas; but they were converted into silica by fusing with carbonates of potash and soda.

Crystallised silicon is insoluble in hot solutions of carbonate of soda, but soluble, with development of hydrogen, in hot solutions of caustic potash, and also in hot hydrofluoric acid. In working at the determination of silicon in cast iron at the Mining Institution, there has never been occasion to suspect the presence of crystallised silicon. Cast iron which had a thin white pulverulent coating of silica on its surface, has been sometimes observed.

After fruitless efforts to dissolve iron in highly diluted organic or inorganic acids, which should have no effect on the refinery slag, such a solvent was finally discovered in bromine, which, when mixed with water, dissolves the iron without the slightest action on the accompanying slag.

But as experimenting with bromine in large quantities is very disgreeable, trials were made to use iodine instead; and this, like bromine, has been proved to have no effect on the slag, nor on the oxide or proto-sesquioxide of iron, or proto-sesquioxide of manganese.

At the same time bromine dissolves iron quicker than iodine, and is, perhaps, more easily obtainable in the requisite state of purity.

Neutral chloride of copper may also be used as a means of solution, if copper is not precipitated.

Moreover, as continued experiments have shown that a solution of carbonate of soda can separate finery slag from the silica, which has been formed by the use of iodine or bromine on the silicon contained in the iron, the following method for the determination of silicon and slag in bar iron or steel has been used and considered successful; the same method may be employed for cast iron, because blast-furnace slag, when such is found, is not perceptibly changed by iodine or bromine, nor by solutions of carbonate of soda.

Three grammes of bar iron or steel which has passed through a sieve of 0·2 of a line at the most (the filing or boring must be made with great precaution, so that no scale nor the least trace of the file may get into the sample, and so affect the results); 15 grammes of iodine are added in small portions at a time to 15 c.c. of water in a beaker of 100 c.c. capacity. The water must be previously boiled to expel the air, which would otherwise oxidise the iron. The iodine is stirred in the water with a glass rod, in order to get rid of the air which has accompanied it, and the floating iodine and iron particles are allowed to sink.

The beaker with the iodine[†] and water, which is kept covered with a watch-glass, is cooled in ice water before the iron is put in, and during the solution it is kept at the temperature of 0° C. For the first few hours it must be well stirred every hour, or oftener, with a glass rod, but afterwards not so frequently.

By means of the low temperature and the careful admixture of the iron (by which heat is prevented), the solution may be performed without the least development of gas, and the iron has less inclination to become oxidised by the air at this low temperature.

By pressure, and by agitating with the glass rod, the solution of the iron particles which collect at the bottom of the beaker is much facilitated; but if no iron is visible, the beaker may be kept at an ordinary temperature, or, preferably in ice water. If some of the solution has risen, and dried up on the sides of the beaker or on the glass rod, it must be well moistened with the same solution before the water is added.

About 30 c.c. of water, which should be very cold in order to prevent the formation of basic salts, are added to the solution; it is then well stirred, left to settle, and the fluid with the lighter particles of graphite is poured into a filter of 2 in. diameter; the filtration is kept up without interruption until there remains only a somewhat heavy dark powder of slag, &c.; at the bottom of the beaker about 5 c.c. of water, with a few drops of hydrochloric acid, are now poured in and stirred with the glass rod; if hydrogen gas is given off, it is an indication that there is still some metallic iron undissolved.

The acidified water is quickly poured on the filter in order not to act on the slag. If a development of gas is perceived, a little iodine, with carbonate of soda and water, is added for the complete solution of the iron, and the residue is thrown on the filter and washed with cold water, until a drop of the filtrate gives no reaction with a solution of 0·2 per cent of ferrocyanide of potassium contained in a small porcelain crucible. Iron solutions containing 0·00001 gramme of oxide of iron per c.c. show in this way very distinct reactions, particularly if a drop of nitric or hydrochloric acid be added. The filtrate is evaporated to dryness, in which operation some of the iodine is sublimed away. Thirty c.c. of hydrochloric acid, 1·12 sp. gr., are then added, and it is again evaporated in order to obtain the silica which may be dissolved in it. When intending to estimate the amount of graphite, it must be washed only with water, because hydrochloric acid would dissolve the slag.

The filter, previously dried and weighed, is again dried and weighed when containing the precipitate. It is then ignited, and the residue weighed. After ignition, the residue is boiled in a solution of soda, in order to extract the silica, and weighed. It should be observed that some part of the silica which has been formed from the silicon in the iron may possibly unite with the slag during the drying and ignition. In consequence of this, it is difficult to extract it by means of a soda solution, whence this method is not to be recommended in exact determinations of silicon.

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[*] From *Engineering*, July 24, 1868. Translated by C. P. Sandberg.

[†] The iodine should not leave any residue when exposed to a high temperature. Impure iodine may be purified by sublimation in the following manner: It is placed on a large watch-glass resting on a plain glass plate, and heated on a sand-bath to 107° (the melting-point of iodine), a plainly polished beaker is inverted over the watch-glass, and on this the iodine is condensed. The purity of the iodine may be tested by dissolving in it 3 grammes of iron containing a small but accurately determined amount of slag; if these results agree, the iodine may be considered fit for use.

When using bromine as a solvent, there must be taken 6 c.c. to 3 grammes of finely powdered iron or steel with 60 c.c. of water, which has been previously boiled, and cooled to 0° C.; and this temperature preserved by placing the beaker in ice water until the solution is complete, which usually takes place in two or three hours; it is cautiously stirred once or twice with a glass rod; if stirred hastily, the solution proceeds too violently. The solution is placed on a table or in ice water, and stirred with the glass rod now and then. The further operations are conducted in the same manner as when using iodine. Bromine is preserved under water, and is taken up by a pipette, which is introduced into the bottle, the upper end being kept closed by the finger.

When it is preferred to dissolve iron or steel in pieces, instead of in powder, it may be done; but in this case it is not necessary to place the beaker in ice water, as the metal is less violently acted upon in this form. Several days are required for the solution; the iron, and particularly the steel pieces, must be kept clear from the graphite which adheres to their surface.

In experiments using the solution at the temperature of 40° C. for iodine, and 25° C. or 30° C. for bromine, it occasionally happens that yellowish-brown basic salts have formed; therefore this temperature must not be used, but the solution of iron ought to be operated upon at a temperature of 0°.

In order to determine the silica (formed from the silicon in the iron) and slag, the filter, which contains graphite (in combination with iodine or bromine and water), silica, and slag, is unfolded, whilst it is still wet, on a watch-glass. The contents are washed away from the filter (which ought to rest only upon one-half of the filter whilst in the funnel) with a very fine jet from a wash-bottle (so as not to obtain too much water) into a platinum or silver crucible of the capacity of 30 c.c. The loosening of the mass may be facilitated by a fine paint-brush. The water in the crucible is evaporated to about 6 c.c., 3 c.c. saturated solution of carbonate of soda, free from silica, are added, and the crucible put in the copper ring in a water bath, the hole being large enough to allow the crucible to project ¼ in. above it. It is kept in the boiling water 1 hour, during which time the liquid is stirred two or three times, and the insoluble mass crushed with a platinum spatula. The liquid is carefully poured from the insoluble mass on to a small filter, and to the mass in the crucible is added 1 c.c. of saturated solution of carbonate of soda and 2 c.c. of water. When this has been boiled 1 hour,‡ the whole contents of the crucible are thrown on the filter and washed. The solution of silica in soda is acidified by hydrochloric acid, and mixed with the iron solution, and the whole evaporated to dryness on a water bath. When the solution attains the thickness of ordinary syrup, it is stirred very often with the glass rod, until the mass becomes a dry powder, and heated until the smell of hydrochloric acid has nearly gone off; the beaker is then placed in boiling water for 6 hours, 15 c.c. of hydrochloric acid of 1·12 sp. gr. are then added, and the beaker left on the water bath 1 hour. When the red powder is entirely dissolved, 50 c.c. water are added; and when no crystals of chloride of iron are visible, the solution is thrown on a filter and washed with cold water, warm water forming basic iron salts, which make the silica appear red. The filter containing the silica is drid and ignited in a porcelain crucible, gradually increasing the temperature to a full red heat, and weighed;‖ if silica is coloured red by oxide of iron, a little hydrochloric acid, 1·19 sp. gr., must be poured into the crucible.

(To be continued.)

MR. RODWELL ON PHLOGISTON.*

The theory of Phlogiston is invariably regarded as a distinct development, unconnected with any previous theory, and uninfluenced by any prior mode of scientific thought. The object of Mr. Rodwell in the paper, of which we here give a short abstract, is to prove that "the theory of phlogiston was not the result of a sudden development; it did not owe its existence to an intellectual exploit, but it arose by a process of evolution, and by a gradual *modus* of development.

In Section 1 ("*Of the subtilis ignis of the Ancients*") the author shows that from the earliest times philosophers recognised a subtle fire innate in matter, and distinct from ordinary fire. The opinions of Zeno, Chrysippus, Lucretius, and others, are quoted to this effect. In the four element theory *fire* ("under which term was included light, the heat inherent in all bodies, flame, incandescent bodies, together with lightning, and all visible manifestations of electricity") was regarded as the *anima*, while air, water, and earth together constituted the *corpus*. Passing on to the Middle Ages (Section 2. "*Of old Chemical literature, and of the significance of the terms sal, sulphur, mercurius, as employed by mediæval chemists*") we find the four element theory existing nearly the same in form, but somewhat modified in name, in the three chemical principles, Sal, Sulphur, Mercurius. These are *principia*, not (as is too often imagined) *corpora*: "they are *ἀνάλογα*—representative bodies, types of classes, type of qualities." The fire of the four element theory was included in *sulphur*, the principle of combustibility. Into this section an account of some old typical chemical works is introduced, together with some remarks upon the rise and growth of the system of chemical symbolisation.

Section 3 treats "*Of the supposed nature of fire prior to the rise of the theory of phlogiston; specially of Descartes' 'Materia Cœlestis,' and of Hooke's Theory of Combustion.*" It is here shown that from early times the idea of intestine material motion has been connected with heat. The Cartesian philosophy is discussed, and a connection traced between the *Materia Cœlestis*, and the *subtilis ignis* of earlier writers. The extended Cartesianism of Lemery is touched upon, and the following passage (which bears upon the history of thermo-dynamics) is quoted from his *Cours de Chimie*, published in 1675:—"But because there may be some difficulty in conceiving what is meant by little igneous particles ("*corpuscules ignées*") I do understand by them a subtle matter, which, having been thrown into a very rapid motion, still retains the aptitude of moving with impetuosity, even when it is enclosed in grosser matters; and when it finds some bodies which by their texture or figure are apt to be put into motion, it drives them about so strongly that their parts rubbing violently against each other, heat is thereby produced."

Section 4 treats "*Of the ideas regarding the calcination of metals which prevailed prior to the rise of the theory of phlogiston.*" From this we learn that Glauber suggested that the increase of weight observed in some metals after calcination might arise from the coagulation of heat by the metal during calcination; while Boyle assigned the gain of weight to the absorption of "*extinguished flame*," or, as he otherwise expresses it, of "*igneous particles;*" and Lemery, to the assimilation of "*corpuscules de feu.*" These views were in all cases published before Stahl wrote on phlogiston.

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‡ 0·1 gramme of ignited and pure silica obtained from analysis is dissolved in the above manner in 6 c.c. of a saturated soda solution and 12 c.c. of water. If any residue is observed after the second boiling this arises from some impurity which has united in small quantities with the silica, rendering it insoluble. When strong hydrochloric acid is boiled with this insoluble silica, it may afterwards be dissolved. When the solution from the 1 gramme of silica is diluted with water to the volume of 50 c.c. at the ordinary temperature, it has no tendency to come into the form of jelly. Quartz powder is dissolved by the preceding method, but very slightly, but ignited titanic acid and finery slag are not acted upon, and the tersilicate slag from blast furnaces but very little.

‖ When the silica is quickly exposed to a high temperature, a considerable loss may arise from the spirting of the water combined with the silica. Silica dried at 100° C. has been proved to retain 1 equivalent of water to 3 equivalents of silica, that is, about 6 per cent of water, which is lost by a strong ignition.

* "On the Theory of Phlogiston."—*Philosophical Magazine for January*, 1868.

In Section 5 we have an account "*Of Becher and Stahl, and of the rise and development of the theory of phlogiston.*" The writings of Becher are here discussed, and it is shown that he has used the word φλογιστον solely in its original adjective sense; while "Stahl converted Becher's φλογιστον into a substantive, and applied it to designate the *materia ignis*, so often spoken of in the works of former writers on chemistry; and at the same time he endued it with certain extended functions, many borrowed from Descartes, some added by himself.

Phlogiston was defined by Stahl as "*materia aut principium ignis, non ipse ignis,*" and was conceived to be "a very subtle matter, capable of penetrating the most dense substances; it neither burns, nor glows, nor is visible; it is agitated by an igneous motion (*igneo motu*), and it is capable of communicating its motion to material particles apt to receive it. The particles when endued with this rapid motion constitute visible fire . . . . . The igneous motion is '*gyratorius seu vorticillaris.*' . . . . Heat is an intestine motion of the particles of matter.'" As an almost invariable rule the expression '*loss of phlogiston,*' which so frequently occurs in the works of the Phlogistians, means in our language, *combination with oxygen;* while "*gain of phlogiston,*" or '*assimilation of phlogiston*' signifies *deoxidation.*

The sixth and last Section treats "*Of the Syncretistic nature of the theory of phlogiston,*" and in this the author summarises the matter of the preceding sections, portions of which summary we give below *verbatim.*

"Phlogiston was a new name for an old principle. We have seen that the idea of the existence of a subtle fire innate in matter has pervaded physical philosophy from the earliest times. *Phlogiston* was another name for the "*pure fire*" of Zoroaster; the *ατεχνικον πυρ* of Zeno; the "*subtilis ignis*" of Lucretius; the "*elemental fire,*" "*astral fire,*" "*sulphur,*" or "*sulphureous principle*" of the chemists; the "*calor cœlestis*" of Cardanus; the "*sideric sulphur*" of Paracelsus; the "*materia cœlestis,*" of Descartes; the "*terra inflammibilis*" of Becher. The functions of this entity had been varied by different thinkers, almost as much as its name, until Descartes gave them accurate definition. The theory of phlogiston was the theory of the "Materia Cœlestis" extended in a chemical direction. Phlogistic chemistry was Cartesian chemistry. Descartes defined the physical functions of the *Materia Cœlestis*, Becher and Stahl defined its chemical functions, and applied them to the explanation of diverse chemical phenomena. Throughout the writings of Becher and Stahl we find a sprinkling of Cartesianism; they did not, however, adopt the system in its entirety; they appear to have discarded the second and third elements, and adopted the first as the parent of their own system. Enough, I think, has been said in the preceding section to show clearly that the dominant functions of the *Materia Cœlestis* were conferred upon its synonym Phlogiston."

"The theory of Phlogiston was essentially and completely a syncretistic theory. It was built up of *idola theatri*, collected from various sources, and these were cemented together by the particular *idola specus* of Becher and Stahl. In this process of syncretism, the merit of these men lay; their fault was a too hasty generalisation. In that stage of chemistry, syncretism was inevitable; indeed all theories are more or less tinctured by it, with the exception of those which emanate from a new mode of experimenting, such, for example, as Kirchhoff's theory of the constitution of the sun. . . . . . A theory proceeds by slow evolution until it dominates, or is destroyed. It was thus with the theory of phlogiston: arising under the most favourable conditions, it attained full development, became most cardinal, most sovereign, and fell. For twenty-eight years it was looming a half-formed thing through the mists of chemistry; for thirty-four years it was growing in strength and proclaiming its dynasty; for fifty-four years it was dominant, and it was fully ten years yielding up the ghost. There are men amongst us now who have listened to the echoes of its departing steps. Becher and Stahl were the prophets of a new mode of chemical thought, essentially classificatory, systematic, and syncretistic. In their day chemistry was at the commencement of a period of transition, and they bridged the gap which existed between empirical chemistry and modern chemistry. They did not collect the materials for the structure, they did not altogether construct it, but they designed it, and helped in the work of building. Albeit a bad bridge, and built upon shifting sands, yet it was a channel of escape from mystic science, and many passed over to take refuge on the other side." The author concludes as follows:—

"Of the influence of the theory of phlogiston, I need say but little. It was not the first chemical theory; it did not give the first explanation of combustion, and it was established in the face of facts which carried with them its refutation. When the first stage of its development was passed, facts were adapted to the theory, and phenomena were tortured and garbled so as to fit in with it, by which means the progress of chemical science was somewhat retarded. Even when Lavoisier had conclusively proved the fallacy of the theory, this blind adherence shut the eyes of the phlogistians to the merits of the new system, and to the utter falsity of their own. Nevertheless, the theory exercised influence for good; for by its means a certain amount of order was introduced among a vast chaotic mass of chemical facts, and phenomena were classed together, and reasoned upon together, and together submitted to similar processes of mental analysis, after the manner so strongly advocated by Francis Bacon."

"When Mde. Lavoisier, habited as a Greek priestess, burnt the writings of Stahl upon an altar dedicated to the new science, the downfall of the theory of phlogiston was not alone typified; for in that holocaust perished the vast system of empiricism which had pervaded chemistry from the time of its origin until then—relics of Egyptian and Chaldæan lore, of an age of fanaticism, of intellect perverted by a false enthusiasm. Phlogistic chemistry had arisen on the ruins of the older structure of mediæval chemistry, and from it arose modern chemistry. Let us be fain to remember that the mother died in giving birth to the child. The new science was, as Dionysius, born of the dying Semele; and while we worship the son, like the Ancients we have not forgotten to raise a statue to the mother."

Volumetric Determination of Acetic Acid.—G. Merz. The determination of acetic acid by means of a standard solution of sodic hydrate is rendered difficult, by the fact, that sodic acetate imparts a violet tint to litmus, thus obscuring the final change to blue. This inconvenience may be obviated by using curcuma tincture, which remains yellow so long as free acid is present, and changes into brown when the point of neutralisation is reached.—(*Journ. pr. Chem.* ci. 301.)

Determination of Ammonia.—A. Vogel. In cases where ammonic salts have to be determined in presence of albuminoids, the author employs magnesic oxide for the liberation of ammonia in preference to potassic, sodic, or calcic hydrate, which would disengage ammonia from the organic matters. He mixes the substance to be analysed with magnesic oxide, and places it together with a measured quantity of sulphuric acid of known strength under a bell-jar. After about 4 days all ammonia is absorbed by the acid, and is then determined as usual.—(*Z. f. Kübenz, Ind. im Zollv.* 1867, 100.)

ON

HEAT AND COLD;

A COURSE OF

SIX LECTURES[*]

(Adapted to a Juvenile auditory),

DELIVERED AT

THE ROYAL INSTITUTION OF GREAT BRITAIN,

(*CHRISTMAS*, 1867—8),

BY

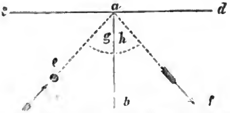
JOHN TYNDALL, Esq., LL.D., F.R.S.

Lecture VI.

Reflection, refraction, and absorption of radiant heat.—The heat of the sun.—Visible and invisible rays.—Extraction of light from the rays of heat.

In our last lecture I endeavoured to explain to you the law according to which radiant heat is reflected. I then made use of some terms which were, perhaps, rather difficult to remember. I explained to you that the angle of incidence was equal to the angle of reflection, so that if you suppose the surface of this table, *c d*, to be a reflecting surface, and this rod *a b*, a perpendicular to the surface, when a ray of light, *c a*, falls upon the surface, striking the bottom of that perpendicular, the ray is reflected so as to lie as far to the left of the perpendicular as the direct ray lies upon the opposite side of it. That is to say, the angle of incidence, *g*, on the one side is equal to the angle of reflection, *h*, which is on the other.

Fig. 1.



And now I have to draw your attention for a moment, not to the reflection of light or radiant heat from planes or flat surfaces, but to the reflection of radiant heat from curved surfaces. I have such a surface here. It is a large concave mirror, as it is called. It forms part of a large sphere of glass: it is, as it were, a slice cut from a large sphere of glass. Now, suppose a sunbeam to come in this direction, and fall plumb upon the mirror: you see that the edges of the mirror are bevelled or slanted off, and the consequence is that that sunbeam striking on it would be reflected in such a way that the reflected rays would converge and form a cone of convergent rays. I want to show you that when light is thus reflected from a concave mirror it is gathered up to a point which is called a focus. We will now throw a beam of light upon it. You can not see light itself, but you can see bodies illuminated by the light; and in this room, and especially in London air, and, indeed, in all air, there is a considerable quantity of common dirt floating in the air, and these dirt particles will be illuminated by the beam of light; and I think this will enable you to see that after reflection the beam of light will be gathered up and brought to a focus. You see the beam is now reflected from the concave mirror and is gathered up in this wonderful way into that convergent cone. If we had time, we might prove that this must be the manner in which the rays would behave after reflection in accordance with the law that the angle of incidence is equal to the angle of reflection.

Now, having shown you this convergence of the rays of light, I want to show you the reflection of the rays of heat; and for that purpose I have not a single mirror, but two mirrors. They are called "conjugate mirrors," and one is suspended over the other. I have here the means of obtaining the beautiful electric light from a battery of fifty cells: if I now place this light in the focus of this mirror the rays will be reflected upwards, and if the mirror were perfectly true they would be reflected upwards in a parallel beam, or, so to say, a solid cylinder of light. Now remember what occurs. The rays of light will fall upon this lower mirror; they will be reflected upwards by it in a straight cylinder; that cylinder of light will strike upon the upper mirror, and will be converged, and reflected again from the upper mirror, and brought to a point in what is called the focus of the upper mirror. You will see these rays of light going upward through the dust of the room when the room is darkened. I intended to have a silver bead in the upper mirror; and if it were there you would see it shining with the brilliancy of the sun, owing to the convergence of these rays of light in the upper mirror. If I put the light in the upper mirror instead of the lower one, the rays would be brought to a focus in the lower mirror. I want to show you this with heat; and for that purpose I will take some boiling water. I lower the upper mirror and hang in its focus a flask of hot water; and now we will examine what occurs with the rays of heat. Having placed the flask in position, I draw the mirror up into its former place near the top of the house: and now the rays of heat are coming down from that hot water. Although you can not see them, they are coming down as the rays of light which were given off from the electric light just now. The rays of heat are striking upon the surface of this mirror, and they are collected and brought to a focus here. I think that by means of our beautiful thermo-electric pile I shall be able to show that this is really the case. I now bring the face of the pile under the mirror, turning it downwards—not upwards, towards the hot water. You observe that the needle very soon moves, in virtue of the heat which is reflected by the lower mirror and collected to a focus in this way. I will now turn the face of the pile towards the cool region of the room, and allow its heat to waste itself; and now for the flask of hot water I will substitute a totally different body—a very cold one. I will, in fact, place a freezing mixture in the focus of the upper mirror, and then operate with the pile exactly as I did when the flask of hot water was there. You will now observe that the needle will move in the opposite direction. It will first come down to zero, and then move up on the opposite side. There will be a very sensible deflection, indeed, if I hit the right point. [The deflection took place as indicated.] Now, I dare say many boys here present think that, as rays of heat issued from the vessel containing the hot water, so rays of cold issue from the vessel containing the freezing mixture. That, however, is not the case. In the case of the freezing mixture our thermo-electric pile is the warm body. It is hot compared with the freezing mixture, and that pile radiates its heat against this lower mirror; the heat is reflected above, is re-reflected against that mirror, and is then absorbed and drunk up utterly by the freezing mixture, so that the pile in this way wastes or loses its heat, and therefore gives that deflection of the needle due to cold. Instead of this freezing mixture or the bottle of hot water, I will now place in the focus of the mirror a body which I hope will be given to me in a bright cherry-red hot state. A copper ball has been placed in the fire in the next room; we will suspend that copper ball when it is red hot in the place which was occupied by the freezing mixture, and see whether we cannot get very visible evidence of its radiation. I do not like to use the thermo-electric pile in this experiment; but I have here some black paper, and sometimes we are able to make paper smoke in the lower focus. I place this paper below in the focus, but I see the ball is not hot enough to burn it; there is no apparent action; but I can feel the heat very strongly indeed, through the reflection of the rays, so that my hand can not rest there. Some of this paper smoked freely yesterday when brought within the focus. If I place the face of the thermo-electric pile there for a single moment, you will find what I said to be true. The action of the needle proves that you have there the focal heat I have been endeavouring to describe.

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[*] Reported verbatim, by permission of the Author, for this Journal.

Now we have to pass on to the still further consideration of these rays of heat; and I will first of all try to make plain to you wherein consists this wonderful light that we have been operating with so often. I will take a thin slice of this light and try to unravel it before you. The screen will be lowered in order to enable me to do this, and we will lower the roof so as to darken the room. You will see the beam of electric light making itself evident in the dust of the room; and this lens enables me to obtain a beautiful image on the screen. Now I want to twist that beam aside. That white mass of light which you see, is due to a mixture of lights of various colours. I will twist this beam aside by means of a prism, and separate these colours one from the other. First of all I will send the light through a single prism, thus, which gives this wonderful, rich display of colours upon the screen. Nothing can be more beautiful than this—so rich and lovely. And now I will try and make the band still bigger,—not richer: it is impossible to have it richer or more beautiful than that. For the purpose of increasing the size of this band of colours I will send the beam through another of these prisms, which will pull it aside still farther, and spread these colours still more. You now have the beam passing through a second prism, and when I bring the beam into the field you have this splendid band thrown on the screen. This is called a spectrum. This was the great discovery of Sir Isaac Newton. He found that white light was composed of all these colours; and if it were consistent with our present course of lectures, we could make these colours combine again and form white light. We will now turn up the gas, and you see how dead the spectrum becomes when the light falls upon it. I asked for the gas light in order to choose a boy "ruddy, and of a fair countenance." [The lecturer then selected a boy answering to this description, and led him to the screen. The room was then again darkened.] You will find what happens to the colour of his face when I lift him into the midst of this spectrum. Here [holding the boy's face in the red light] he is blooming like a rose. Now [transferring him to the yellow] he is like something very different from a rose.

Now I want to say a few words upon this wonderful spectrum. You see a great mass of light here, and you might suppose that that is all which comes out of that wonderful electric lamp; but that is, in reality, not at all the case. You have here a certain distance which is rendered visible to the eye by these splendid colours, but there are rays extending about as far on the outside of the extreme red, as the green colour is on the other side of it. The most powerful radiation emitted by the electric light does not fall on any part of the visible spectrum, but it falls as far on one side of the red as the green is from the other. And so also at the other end of the spectrum we have a vast body of rays stretching out beyond the visible portion; but all these ultra-violet rays and the ultra-red rays are perfectly incompetent to produce vision, although a great number of them reach the retina. I now want to make evident to you the prolongation of the spectrum in the direction of the violet, and for that purpose I must make use of a less expansive spectrum. We have produced this by means of prisms of liquid, but I must now make use of a prism of glass, or else have only one of the liquid prisms instead of two. I want to give you an idea of the comparative power of the luminous rays and those dark rays I have spoken of. I have now produced this present spectrum by means of one of the liquid prisms. We might, as Sir William Herschel did when he first discovered the dark rays of the sun, place a thermometer in this dark part beyond the red, and we should find that it would show an augmented temperature because of the heat falling on it from the electric light. Then if we travelled from this red end of the spectrum towards the other, we should find that the thermometer would gradually sink, and if we went back again it would rise gradually through the violet, through the blue, through the green, and the yellow, and the orange to the red, the red being the hottest part of the visible spectrum. But Sir William Herschel did not stop here, but made a further discovery. Far beyond the red he found very powerful rays falling upon the thermometer, and he represented the rise of the temperature by lines of certain length. He represented the least heated part by a short line, and the next by a longer one; the line representing the heat of the green is of a certain length; and the heat of the yellow was marked by a longer line still. The whole visible radiation from the sun was determined in this way by Sir William Herschel; but we have now far finer methods, and with the electric lamp which you now see before you, we went over these colours with a thermo-electric pile. The whole radiation of the visible portion of the spectrum is represented by this small coloured area that you see represented on the diagram; but over and above that, and beyond the red end of the spectrum, you have an amount of heat which is represented by this great mountainous peak. The invisible radiation is nearly eight times the visible; that is to say, only one-eighth part of the rays emitted by the electric light is competent to excite vision, all the rest are rays of heat, and not rays of light.

And now I want to show you the prolongation of the spectrum in the other direction; and for this purpose I will make use of a prism of flint-glass instead of this prism of bisulphide of carbon. I place the prism exactly as in the former case; the display of colours is not now quite so brilliant, but the glass is more transparent to the rays that I want to show you than the bisulphide of carbon is. I have here a certain substance called sulphate of quinine; and I have here also a screen of white paper which was wetted with this substance before the lecture. It was found by Professor Stokes that this substance has the extraordinary power of rendering visible these invisible rays of light beyond the violet. Now, observe this band of light which becomes visible beyond the violet, when I introduce the paper screen which has been spread with the sulphate of quinine. There is darkness when the screen is not there, but when it is held up you see this lovely band of colour produced. If I take the liquid itself and daub it upon a piece of paper, it will render the invisible rays visible. I have here also the means of changing the colour of rays by means of this beautiful violet glass, and rendering rays visible which were hardly visible before. Here is a piece of paper, on which are printed the words "A happy new year." As you look at it you see nothing upon it, by the ordinary light, but if we put up the violet glass observe how beautifully the letters come out.

So much, then, for the existence of rays beyond the red end of the spectrum, and also beyond the violet end, which are incompetent to excite vision. These are what are called invisible rays. Before I proceed farther I should like to show you an experiment by means of these powders. Professor Stokes has called that action which makes the sulphate of quinine visible, "fluorescence." The phenomenon called fluorescence has been known to philosophers a long time. It was observed that certain substances had the power, so to speak, of drinking in light, and then giving it out gradually. M. Edmond Becquerel, of Paris, has rendered himself exceedingly famous by his investigations on this subject, and the powders I have here were selected by him. I am indebted to Sir Charles Wheatstone for them. I will show you that if these powders are shone upon by the electric light, and then the lamp is extinguished, the powders will still retain their luminosity; they will still have the power of giving out light. They, as it were, drink in the light and then give it out slowly and by degrees. [The powders were exposed to the electric light for a short time, and the light was then extinguished.] There, you see the powders are self-luminous, and emit this beautiful light. I have here a beautiful butterfly formed of these powders. It is painted upon glass. You see the surface of the glass is now perfectly dark. It emits no light; but if I allow the light of the sun or the light of the electric lamp to shine upon it for a short time, you will see that it has the power of drinking in that light, and emitting it gradually. [The surface of glass on which the butterfly was painted with the fluorescent powders was exposed to the electric light. The light was then withdrawn and the butterfly was seen to have become luminous.] This beautiful butterfly is produced by means of these fluorescent powders selected by M. Edmond Becquerel.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 20th.

Dr. A. W. Williamson, F.R.S., Vice President, in the Chair.

At this meeting there was an unusually full attendance of Fellows, and several guests, amongst whom were Sir Roderick Murchison, Professor John Morris, and other distinguished members of the Geological Society. The limited accommodation available in the meeting room was altogether insufficient to provide for the large audience that attended on Thursday evening. This inconvenience has been sorely felt on several recent occasions, and particularly when special evenings have been appointed for lectures. It is to be hoped that the new apartments, about to be constructed for the Society in Burlington House, will meet not only present requirements, but provide for future contingencies.

Mr. Martin Murphy, of the College of Chemistry, Liverpool, was duly elected a Fellow of the Society. The names of candidates read for the first time were—Mr. R. Calvert Clapham, Walker Alkali Company's Works, Newcastle-upon-Tyne; Rustomjee Byramjee, M.D., Assistant-Surgeon in Her Majesty's Bombay Army; and Edward Mensel, Ph.D., recommended by the Council as Associate. For the second time were read the names of Benjamin H. Paul, Ph.D., 8, Gray's Inn Square; Edward Dowson, M.D., 117, Park Street, London; Mr. Thomas William White, Ifield, near Crawley, Sussex; and Mr. Reinhold Richter, of the Rothamstead Laboratory, proposed as Associate.

Mr. David Forbes, F.R.S., &c., then delivered a discourse "*On Chemical Geology.*" The lecturer confined himself mainly to the consideration of those parts of the subject which comprehended the period coincident with and subsequent to that stage in the world's history known as the cosmogenetic era. Confessing at the outset that he was neither absolutely Plutonic or Neptunic in his opinions regarding the origin of the oldest rocks, the lecturer argued that combinations of the views held by these rival schools of geology best suited the requirements of modern research. It was neither fire alone, or aqueous agency alone, that accounted for all the natural phenomena observed, but to these forces conjointly must be added the effects of heat, electricity, light, and mechanical pressure, as greatly influencing the consideration of the matter in hand. Referring to specimens on the table, Mr. Forbes showed that silica occurred in nature as an igneous product in recent volcanic lavas; as an aqueous product in different forms deposited from solution; and as a gasolytic product in tubes from the decomposition of the fluoride of silicon. Similar modifications were observed in the case of sulphur, copper, and many other substances. The conditions under which the artificial formation of felspar and zeolites was possible were then alluded to, and stress was laid upon the fact that the production of the latter (hydrous silicates) by fire was consistent with the observation that vast volumes of aqueous vapour escaped together with solid and partially liquefied matters during volcanic eruptions. Igneous action in nature was defined to be volcanic action in which the results were much modified by the presence of steam and gases. Aqueous action also was defined to include the action of dissolved saline matter, gases, air, &c., with or without heat and pressure. Going back to the earliest forms of created matter, the chemist assumes that the elements and their affinities were then the same as now, subject, however, to the disturbing causes due to excessive heat or relative bulk; thus, whilst sodium will at comparatively low temperatures decompose carbonic acid, carbon will, on the other hand, take the oxygen from soda if the heat applied be sufficiently intense. So also with iron, which at a red heat decomposes water, whilst hydrogen at the same temperature effects the reduction of oxide of iron. Claiming a certain amount of latitude in the discussion of the states of combination or balance between the affinities of the earth's contending elements, it was conceived that the first operation of the newly created matters would be to obey the law of gravity, and arrange themselves in zones or strata in and upon the earth according to their respective densities, although modified to some extent by diffusion. Defining the relative position of the silicates, those more basic in character and of greater density underlying the acid silicates, containing probably free quartz, the chloride of sodium and other volatile compounds may be conceived to form a dense vapour or atmosphere immediately surrounding the earth, whilst carbonic acid, and, next, the gaseous constituents of air with aqueous vapour in the upper regions, were the outer zones. Later, when by the abstraction of heat the chloride of sodium was condensed, it formed a solid crust of salt upon the surface of the earth, and by a further reduction in temperature the liquefied water would dissolve the salt to form the ocean. Reasons are given for the hypothesis adopted by the author, which asserts that the central nucleus of the earth must contain an accumulation of the denser metals and their compounds; these considerations are founded upon the knowledge of the mean specific gravity of the earth, about 5·4, and the density of the exterior crust, assumed to be 2·75.

By this solidification of the exterior crust, and its becoming subject to volcanic and other forces irregularly exerted, the physical features of the globe were changed from a true sphere to mountains and valleys, some of which have afterwards been covered by the ocean; and then by the disintegrating action of water, the ingredients composing the first formed rocks may have been sorted into sandstones, derived chiefly from the quartz, and the earthy silicates go to form under great pressure and metamorphic action the numerous class of slaty or argillacious stratified rocks. Metallic sulphides occurring in the silicates would by oxidation furnish sulphates, which would also be formed from volcanic emanations, and pass into the sea. Organic life at this stage came upon the scene, and was instrumental in separating the lime as carbonate from dissolved calcareous salts, thus forming limestones; whilst vegetation proceeded apace, and gradually stored up carbon from supplies of carbonic acid abounding in the earth's atmosphere, and fitted the air for the respiration of animals.

The arguments deduced from the specific gravity of the quartz contained in granite as pointing to its aqueous origin, are shown to be fallacious, and the author finds that recent lavas contain quartz of specific gravity 2·6, which exactly accords with that of the common hexagonal variety known as rock-crystal.

After duly weighing the conflicting opinions which have divided geologists as to the origin of granites, the lecturer was satisfied from his experience in the field, assisted by the microscope and laboratory, that many of the so-called granites and gneisses are really sedimentary products of the breaking up of true igneous eruptive rocks, stratified by aqueous agency, and subsequently re-consolidated. True eruptive granites of igneous or volcanic origin also undoubtedly exist, and the lecturer replied to the arguments put forward by those who dispute such an origin. The objections were taken *seriatim*—1st, That granite contains free quartz; 2nd, That the specific gravity of the quartz is 2·6; 3rd, That the quartz contains water; 4th. That in granite the more fusible minerals have sometimes become solidified and crystallised before the less fusible ingredients; and 5th, That granite frequently contains hydrated minerals. Reference was here made to Bunsen's experiments on the retention of water by hydrous silicates, and Laurent's observations to the same effect in the case of the fused borates. A specimen of crystallised stilbite, found in the lava current from Etna, in March 1865, was exhibited; and the quartz from the volcanic lavas of Peru, and rocks of Ponza, in the Bay of Naples, were said to contain water. In the lava from Vesuvius crystals of refractory leucite were frequently found sitting upon the easily fusible augite. From the general uniformity in composition and physical characters of volcanic products thrown up in such widely distant localities as Iceland and Terra del Fuego, the lecturer argues that there must still exist a vast reservoir or reservoirs of fluid igneous matter in the interior of the earth, and that volcanic eruptions must have some intimate connection with one another. Volcanic action does not seem to be confined to mere local outbursts, for in the Pacific enormous energy is shown in the numerous volcanic islands lying between 80° and 130° west longitude, which includes a range of nearly one-seventh of the total circumference of the globe. By way of conclusion to his discourse the lecturer divided the forces determining metamorphic action into six principal classes, considered under the following headings:—

1st. Pressure alone.

2nd. Heat alone.

3rd. Heat in conjunction with chemical action and crystallisation.

4th. Aqueous action, assisted by heat and pressure.

5th. Gasolytic action.

6th. Combinations of two or more of the above agencies.

The author's aim was neither the introduction of novelty, nor the rehearsal of published opinions with a statement of authorities; but to bring together a mass of "dissociated data," examine the soundness of the separate parts, and, if possible, build up a structure upon which the criticism of both chemists and geologists could be centred.

The Chairman moved a vote of thanks to Mr. David Forbes for his highly interesting communication, which bore evidence of much study and thought, and invited an expression of opinion from Sir Roderick Murchison and the other geologists whom he saw in the room.

Sir Roderick Murchison said he had listened with great pleasure to the able discourse just now delivered by Mr. Forbes, but felt as yet incompetent to offer any opinion upon the great chemical questions treated of in the paper, particularly those referring to the primitive constitution of our globe, in which the lecturer had grappled so manfully and so successfully with the advocates of the water hypothesis. The facts stated, and inferences deduced from the structure of rocks, go far towards invalidating the opinion of those who assert that the older granites are really sedimentary formations. The igneous origin of at least some of the granitic rocks seemed all but proved, but gneiss may be difficult to determine. With regard to intrusions several interesting examples had been mentioned. When grand ranges of limestone became suddenly changed into gypsum and dolomite, the true explanation could only be furnished by chemical investigation; Daubrée had already done much, and Forbes showed himself ready and willing to go into the arcana of these mysterious regions of speculation, and seek the truth for our science of Geology.

Prof. McDonald acknowledged himself to be a believer in the Neptunian system, and conceived that there was no clear line of demarcation between the granite proper and mica slate; he saw no reason to apply the term "metamorphic" to the latter, since the same ingredients were present in both, and the difference between adjoining portions of rock were often difficult of recognition. If the cavities in the quartz of true granite were carefully examined, they would be found lined with crystals or bounded by plates, and totally different from the hollow amygdaloid spaces occurring in volcanic lavas, and that the fluid contained in them was of an explosive nature.

Professor Morris disputed the accuracy of the inferences drawn from the occurrence of zeolites, which had in the speaker's opinion been crystallised from water. This class of minerals never occurred in modern lavas, but were generally found in the older rocks. Stilbite, chabasite, &c., may be regarded simply as modifications of ordinary felspar. The subject of metamorphism required elucidation from the chemist, and some interesting facts had been brought forward in the paper. Remarkable examples of alteration at the junction of rocks were to be seen in the passage of granite amongst limestone. Where grey granite intruded into mountain limestone, the lime felspar was produced, which segregated out in different forms of metamorphism.

Dr. Hugo Muller said, "I have listened with great pleasure to the very interesting discourse of my friend Mr. Forbes, and in pronouncing my concurrence with most of the views put forth, I cannot help expressing some doubt with regard to the validity of his arguments in favour of the igneous origin of the quartz in some of the granite and similar rocks. Mr. Forbes regards the separation of graphite from pig iron, as shown in the beautiful specimen placed before us, as analogous to the separation of quartz in granite, inasmuch as both substances previous to their separation were in the state of igneous solution. Now it appears to me that this analogy is only very superficial, for in the case of pig iron we see the more infusible graphite separate in a *solid* and crystalline form as soon as the affinity to the iron ceases, whereas, on the other hand, in the case of the granite, we have the undisputed fact that the more fusible felspar has separated and crystallised first; for the quartz surrounds, and, in fact, to a great extent fills up the space between the crystals or particles of felspar. On the other hand, the well defined surface of the felspar and the absence of all indication of partial interfusion on the faces of contact between the two minerals, excludes all probability that these felspar particles could ever have been in contact with fused quartz, leaving untouched the question whether the once fused quartz is capable of passing again into the crystalline state without solidifying. Mr. Forbes, in support of his views, quotes the highly interesting and important researches of Mr. Sorby on the structure of water cavities in quartz and other minerals. If I recollect rightly, the highest temperature deduced from their experiments for the formation of these cavities, is about 400° C., or about the melting point of lead. But surely this is not a temperature which we can call 'igneous,' or associate with plutonic action, it is in fact a temperature which we, if the present theory on the subject is correct, may find anywhere at a depth of about 20,000 feet below the surface of the globe, and to which in the course of time any of the sedimentary formations may have been subjected. The trachytes of Ponza and

Palmarola, a rock of decided volcanic origin contains crystalline quartz, the water cavities of which are, according to Mr. Sorby, formed at a temperature of about 360° C. This fact in itself I consider a proof that their quartz is a secondary product, and could not have crystallised at the time of the eruption of their lava, for it is inconceivable that quartz could remain liquid at the temperature of melting lead. It is hardly necessary to mention that the eruption of these trachyta has taken place in pre-historic times. The fact that quartz and zeolites have been taken from the still flowing lava is not more conclusive, for it seems more than probable that these minerals, along with many others generally named amongst the Vesuvian ejections, are nothing more than particles of the ancient Monte Somma formation, underlying the present volcano, which during the eruption of Vesuvius come occasionally within reach of the lava, and are then ejected from the crater. I have arrived at this conclusion after a personal inspection of the Monte Somma formation, which in reality consists of the lavas, ashes, or tufa, and débris of the ancient volcano mixed up with occasional fragments and blocks of limestone. In the course of time a metamorphic or chemical action has set up in this mineral chaos the result of which are those numerous well crystallised minerals which are found in such positions as to quite exclude the idea of their formation having taken place simultaneously with the Monte Somma itself. If we find these very same minerals, sometimes even in the very same kind of geodes and association in which they occur at the Somma, ejected from the crater of Vesuvius, I think we may safely conclude that they are *not* the products of the active volcano."

Dr. B. H. Paul considered that an effort should be made towards establishing the broad principles upon which chemists were required to investigate geological phenomena. Schistose rocks were found underlying, or formerly did so, other sedimentary strata. This being the case, the examination of the chemical features of difference was a matter of importance, particularly in the event of their becoming crystalline. The speaker could not agree with Mr. Forbes in considering that the uniformity was not so great in sedimentary as in crystalline rocks. The former class were remarkable for their uniformity; thus mica-schist, chloritic-schist, and hornblende exhibited differences only of small degree. For his own part, whilst he abandoned both the plutonic and aqueous theories, he could not adopt Mr. Forbes' reasoning in respect to the quartz in granite.

Dr. A. W. Williamson agreed with the lecturer in most of his arguments, but there was one point in his "chapter of Genesis" which seemed to require further explanation. It had been stated that in the primeval atmosphere the gases would arrange themselves, or be stratified, in the order of their density, but for his own part he should not have expected to find them in this order, but rather obeying the law of diffusion. Some time since, when visiting the blast furnaces of the Cleveland district, he was much struck by seeing a block of slag, weighing perhaps 2 tons, standing upon an iron truck having been just run from the furnace, and whilst cooling a workman perforated the upper crust, when a stream, as of lava, flowed from the aperture, being forced out by the contraction on all sides of the mass.

Mr. Forbes, in reply, reminded Professor McDonald that he did not pin his faith to any school of geology, and, with respect to the cavities in quartz, had always found them very irregular, and certainly not, as a rule, bounded by plates or lined with crystals. Although admitting that zeolites were usually so formed, he could not agree with Professor Morris in considering that they were, in every instance, formed from solution by subsequent aqueous infiltration; although he was indebted to that gentleman for an admirable illustration in the specimen from the aqueduct of Plombières now upon the table. He once had occasion to send a mass of volcanic lava containing zeolites to a lapidary to be cut across; during the process of cutting, water had been used, and so great an action did it exert upon the mass of the rock itself, that it appeared incredible that the zeolites in its interior had been last formed by aqueous infiltration. Mr. Forbes fully agreed with Dr. Müller that many if not most of the Somma minerals could not be regarded as true volcanic products, but it was far different with many of the great eruptions of quartose lavas of enormous extent occurring in other parts of the globe. For some 600 miles along the volcanic range of the Andes of Chili and Peru, quartz in hexagonal crystals occurred in the volcanic rocks, and the microscopic examination of the quartz of recent lavas by Mr. Sorby, showed abundance of "glass cavities" which could only be the result of fusion. The conjoint influence of heat, water, and great pressure, might bring about results which were impossible with heat alone; and this was in harmony with the known prevalence of aqueous emanations (steam) from volcanoes. Mr. Forbes fully admitted that under such influences, the chemical reactions in such volcanic and granitic eruptive rocks may have taken place at temperatures even below a red heat; yet considers this as no reason for not considering them as igneous, since it must be remembered that in geology the terms igneous and volcanic are synonymous. In answer to Dr. Williamson, the speaker stated that the element, time, must be taken into account in estimating the effects of diffusion; he relied upon the instantaneous production of the gases permitting them to obey the laws of gravity, in the first instance, although he admitted that any such arrangement in the atmosphere would ultimately be obliterated by diffusion.

The meeting was then adjourned until Thursday, 5th March, when the following papers will be read, viz.—"*On the Action of Oxidising Agents on Organic Compounds in the presence of an excess of Alkali*"—*Part I.* "*Ammonia evolved by Alkaline Permanganate acting on Organic Nitro-compounds.*" By Messrs. J. A. Wanklyn and E. T. Chapman; "*Note on Dr. Frankland's Process of Water Analysis,*" by Mr. E. T. Chapman; "*On Chloranil,*" by Dr. J. Stenhouse, F.R.S.; "*Action of Nitric Acid on Picramic Acid,*" by Dr. J. Stenhouse, F.R.S.; "*On the Hydride of Aceto-salicyl,*" by Mr. W. H. Perkin, F.R.S.; "*On the Crystalline form of Arsenious Oxide,*" by Mr. F. A. Claudet; "*On the Detection and Estimation of Nitrates in Potable Waters,*" by Mr. E. T. Chapman; "*Action of Zinc Ethyl on Nitrous and Nitric Ethers,*" by Messrs. E. T. Chapman and Miles H. Smith.

On Thursday, March 19th, Mr. Henry Chance, M.A., will deliver a lecture "*On the Manufacture of Glass.*"

CORRESPONDENCE.

CRYSTALLOGRAPHY AND THE BLOWPIPE.—LAW OF HORIZONTAL CRYSTALLISATION.

To the Editor of the Chemical News.

Sir,—May I ask you to allow me to add to the paper published in last Friday's Chemical News, that having by the kindness of the Secretary to the R. A. Institution been allowed the use of their splendid compound microscope, by Smith and Beck, I have been able, since that paper was written, to examine the diaphanebulous vesicles whose crystals, appearing at first like a slight cloud, were far too minute to be distinguished by my pocket lens.

Under an object glass, magnifying 1000 diameters, the primary crystals of baryta had that peculiar hieroglyphical appearance which I have termed grammate. Those of silver were like small flowerets, with three petals, and sulphur (whose vesicle was nebulous) appeared in myriads of tripedal marks like "crowfeet." Under the same glass the zones of the magnesian disc I found to consist of innumerable dark, if not black spots, too small for their shape to be distinguished, even by this powerful lens.

It is now, I think, evident, and I think I may fairly claim the discovery of the fact, that—"When the process of crystallisation in nature is confined to the plane of the superficies of the crystal, and not allowed to proceed in a direction either above or below it, as is the case in the thin 'walls' of the borax vesicles made by me, a distinct system of crystallisation is followed, producing forms widely differing from those generated under other conditions,—never geometrical, generally in the shape of flowers, ferns, trees, or stars, and not isomorphous."

I have the pleasure also to inform you that pieces of the crystalline vesicle can be fastened on clean smooth glass merely by the pressure of a finger, so firmly that they cannot be easily rubbed off, and may be carried about, forming excellent slides for the microscope; when no longer required, they can be washed off with soap and water. I tried electrifying the glass previously, but the vesicles being attracted electrically, they were of course soon repelled.

The truth of the above law may be easily demonstrated by an experiment which I have made since the above was written. I placed a solution of common salt in cold distilled water between two plates of glass, under a pressure of 5¾ lbs.; next morning a reticulate crystallisation was observable on the inner side of both plates, while some drops of the solution, left on the platinum spatula, with which I had mixed it, had crystallised in a modification of the cube.

Nitre treated in the same way produced a kind of floral net-work, while outside it assumed the usual prismatic needles. Carbonate of soda crystallised in a very distinct dendroidate form.

It is necessary to use cold water, because if warmed with some substances, as nitre, the secondary or isomorphous crystallisation is set up so rapidly that the primary kind has not space to form.

It would appear from this that although the law of planiform crystallisation, as above demonstrated, holds good, primary crystals from solution by fire are different from those produced by a solution in liquids.—I am, &c.,

W. A. Ross.

Woolwich, 24th February, 1868.

PHOSPHORESCENCE OF POTASSIUM AND SODIUM.

To the Editor of the Chemical News.

Sir,—In your issue of Jan. 31, 1868, is an extract from the *Journal für praktische Chemie* relative to the oxidation of potassium and sodium. It is there stated that "the oxidation of potassium and sodium, when exposed with a clean surface to the air, is accompanied, according to H. Baumhaur, with evolution of light."

Mr. H. Baumhaur thinks, doubtless, that he is the author of this discovery, but his observation is, in reality, about 17 years old. In the year 1851 M. Pétrie discovered that the metal potassium is phosphorescent when exposed to the air, like phosphorus. He covered the potassium with bees'-wax, and then cut it into two. Each segment remained luminous for about half an hour, the light being one-tenth the intensity of that produced by a piece of phosphorus of the same size.

In 1859 Herr Linnemann, ignorant of M. Pétries' observation, published another note (in the *Journal für praktische Chemie*, lxxv.) upon the same subject. He showed that both potassium and sodium are luminous upon their freshly cut surfaces. The light emitted by potassium is of a reddish tint, that of sodium greenish, according to this author. At 60° or 70° C. the light of sodium is quite as intense as that of phosphorus at the ordinary temperature.

In 1859 I also had occasion to examine the same phenomenon, and recorded it in 1862 in a work which has been more than once quoted in your valuable journal. I found the light of sodium to be very feeble at the ordinary temperature of the atmosphere, and that it ceased when the newly exposed surfaces are covered with a layer of soda. The luminosity lasts for a few minutes, and increases in brilliancy as the temperature rises. Potassium also becomes vividly phosphorescent in the preparation of boron.—I am, &c. T. L. Phipson, Ph.D.

The Cedars, Putney, S.W., Feb. 12, 1868.

THE ROYAL SCHOOL OF MINES.

To the Editor of the Chemical News.

Sir,—Now that the subject of technical education is under discussion, I think that perhaps it might not be amiss to say a few words about the Royal School of Mines.

One, and the principal reason why our Royal School of Mines turns out so few scientific men, in comparison with the corresponding French and German Institutions, is because it is so little known, and many who are aware of the existence of it know little or nothing of its mode of working. The School is itself well worthy of a higher reputation than is at present accorded to it; the Professors are among the most eminent men in their several departments; and the course of study prescribed for the students, extending over a period of three years, and embracing several distinct branches of science, seems to demand more general recognition as an efficient and thoroughly practical scientific education. The School at present is merely an appendage of the Geological Museum, instead of being an institution distinct from everything else, as is the case with the French School of Mines.

In 1854 the Ecole des Mines had 600 associates, whereas ours at the present day has only 40; and as it has been established 17 years, this shows an increase of only 2½ per annum.

I have no doubt that were the Institution brought more prominently before the public the number of students would be greatly increased, and this might be done in several ways.

1st. The chemical and metallurgical laboratories, lecture theatres, &c., should be all in one building. The present arrangement involves considerable loss of time and inconvenience.

2nd. There should be a public opening of the school at the commencement of each session, and addresses should be given, the same as in all our medical schools.

3rd. The diplomas of associateship, scholarships, prizes, certificates, &c., should be awarded publicly at the end of the term; this is done, I believe, at every other educational establishment of any standing.

4th. The "prospectus" and calendar (if it be worthy the name) should be printed and kept in a separate form, instead of, as now, being printed on some of the spare pages of a pamphlet belonging to the Geological Museum.
I am, &c., A. L. E.

MISCELLANEOUS.

College of Chemistry.—All chemists who have studied at the Royal College of Chemistry, as well as present students, will be sorry to hear of the death of Richard Coppins, who has acted as porter in that Institution for more than twenty years. He was particularly obliging and ready in attending to the wants of the students. Apart from his other duties he did some business in chemicals and apparatus, which he was always ready to buy or sell; and most who have passed a session at the College have felt the convenience of having Richard's varied stock to select from in an emergency. He died last week of apoplexy.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

December 2, 1867.

Sir David Brewster, "Letter to Chevreul on the Authenticity of the Newton and Pascal Correspondence." Chasles, "Remarks on the preceding Letter, and on one from G. Govi on the same Subject." L. Laaaoque, "On a Collection of Geological Specimens from Chili." G. Govi, "Remarks on the Letters alleged to have been written by Galileo, which have been published with reference to the Newton and Pascal Correspondence." T. Schloesing, "On the Simultaneous Estimation of Carbon, Hydrogen, and Nitrogen in the elementary Analysis of Organic Substances." Musculus, "On the Hydrates of Stannic Acid." Alvergniat, "An Apparatus for showing that the Electric Spark cannot pass through a Perfect Vacuum." Langlois, "On the Formation of Cyanide of Ammonium by passing the Vapour of Ammonia over Incandescent Charcoal."

Bulletin de l'Académie Royale de Belgique (Classe des Sciences).

October 12.

"Obituary Notice of Michael Faraday." Haidinger, "On the Collection of Meteorites at the Museum of Vienna."

Annalen der Chemie und Pharmacie.

October.

A. Butlerow, "On the Derivatives of Trimethylcarbinol (Tertiary Pseudobutylic Alcohol). On the Isomerism of the Saturated Hydrocarbons C_4H_{10} and of the Butylenes C_4H_8. On Isobutylic Alcohol (Primary Pseudobutylic Alcohol or Pseudopropylcarbinol)." "On the Action of Water on the Chlorides of some Alcohol Radicles." "On the Occurrence of Tertiary Pseudobutylic Alcohol amongst the Products of Fermentation." "On the Action of Hydriodic Acid Gas on the Iodides of the Alcohol Radicles." "On the Crystalline Form of Hexamethylenamine." "On the Non-poisonous Properties of Zinc Methyl." "On the Preparation of Chlorhydrin of Glycol by Carius' Process." A. Butlerow and M. Ossokin, "On Iodhydrin of Glycol and on a new Method of Forming Alcohols by Synthesis." H. Schiff, "On the Ammoniacal Derivatives of Isatin." Schwarzenbach, "On the Mutual Relations between the Equivalents of Albuminoid Substances." P. Lessen, "On some Oxidation Products of Naphthaline." W. Heintz, "Note on the Preparation of Diglycolate of Lime." "On the Action of Dry Carbonate of Soda on Monochloracetic Ether, On Diglycolic Ether and Diglycoldiamide." A. Bettendorff, "On the Allotropic Conditions of Arsenic."

Annales de Chimie et de Physique.

November.

J. Kolb, "Researches on Chloride of Lime, being an Introductory Essay on the Use of that Substance for Bleaching Fabrics." E. G. Lambert, "Analytical Researches on the Nature of the Potable and Mineral Waters of Orizaba, Queretaro, and Monterey, Mexico."

Journal für Praktische Chemie.

November.

D. Huizinga, "On the Detection of Ozone, and on the Presence of this Substance in the Atmosphere." F. Reindel, "On Basic Sulphates of Copper." "On the Production of Prussic Acid from Ferrocyanide of Potassium and Sulphuric Acid." Buchner, "Chemical Analysis of the Mineral Waters of Neumarkt, Upper Palatinate." H. Gruner, "Contributions to the Knowledge of Binitrophenylic Acid." W. Kubel, "On the Estimation of Nitrous Acid by means of Permanganate of Potash." R. Wagner, "On the Solubility of some Earthy and Metallic Carbonates in Water impregnated with Carbonic Acid under Pressure." F. Reindel, "On Soluble Prussian Blue."

NOTES AND QUERIES.

Oxychloride of Magnesia.—If J. E. Hamilton will apply to J. B. Giles, at this address, he may hear of a crude carbonate of magnesia which would doubtless answer his purpose.—Borax Works, Old Swan, Liverpool.

Solvent for Essential Oils.—The only available solvent for your correspondent's purpose is perhaps water itself, in which the oils may be dissolved, or at least mixed in a way which will be equivalent to solution, by the process used by many druggists for making their "aquæ." For every ½ oz. of oil put a good handful of $MgCO_3$ into a mortar and triturate it well with the oil until the latter is thoroughly divided, then add water paulatim, triturating diligently all the time, and filter. The division of the oil is facilitated by previously diluting it with its own bulk of strong spirit of wine, in which case add the water only a few drops at a time at first, but this is not indispensable.—Volta.

Estimation of Tannin.—The most reliable and undoubtedly best mode to estimate tannin is the process devised by Dr. H. Fleck, but a full and complete account of this mode of estimation cannot be given, in N. and Q., since the space cannot be spared. If "Astringent" would give his address I shall be happy to give him a full account of this mode, and also of Muller's mode for estimating tannin. As regards the percentage of tannin in tanning and dyeing materials, the following information may perhaps serve the purpose; oak-bark varies from 10·86 per cent to 15·83 per cent, *Polygonum bistorta* varies from 17 to 21 per cent; sumac, from 12 to 18 per cent. dividivi, from 18 to 25 per cent; nut-galls (Aleppo galls), from 58 to 66 per cent; valonia, from 40 to 45 per cent per cent; catechu, Gambia, from 40 to 50 per cent of a peculiar tannic acid; kino contains from 30 to 40 per cent of the same principle as catechu.—Dr. A. A.

Hofmann's Modern Chemistry.—Lecture Experiments.—Your "Notes and Queries" often have been most valuable to many who seek for information, and cannot find it in books which they consult; for it is a well known saying, that you may have many books and yet never find what you require. The reason I think is, that authors do not trouble themselves about minor points of a subject which perhaps they think only trifles, forgetting all the while that trifles make perfection, and perfection is no trifle. As an illustration of this point I have been reading and closely studying that admirable work "Hofmann's Modern Chemistry," and to make myself master of its contents, I performed nearly all of the experiments, having apparatus made especially for the occasion; it certainly is one thing to read a book of experiments, and another to work them out, as I found when I commenced operation. The first difficulty I encountered was the examination of HCl gas by sodium amalgam. The question I should like answered, is, what per-centage of sodium ought you to use to form the amalgam for this purpose? I have consulted several works, but cannot obtain the desired information. When you have finished the experiment, and emptied the U-tube of sodium amalgam, what is the best method of recovering the pure mercury? I poured warm NH_4Cl upon the very weak amalgam, and let it stand for some days. Is that the best method? My second stumbling-block was in decomposing HCl by the electric current. What ought to be the sp.gr. of the acid? The book says, 1·1. That is very indefinite, because there are about a dozen beginning with 1·1. Does it mean the HCl of commerce, sp.gr. 1·16? In using this said acid I was not successful in performing the experiment, because the liquid became so hot by the action that HCl gas was evolved along with the gases H and Cl. I certainly must admit that these are trifling points, but then they are so necessary for the success of an experiment, and in performing new experiments one desires to know all the little difficulties which may beset them. If some of your corrospondents will help me, I shall feel obliged.—Amateur.

MEETINGS FOR THE WEEK.

Monday.—Royal Institution, 2. General Monthly Meeting.
—— Medical, 8.
Tuesday.—Royal Institution, 3. "On Historical Portraiture," Mr. G. Scharf.
Wednesday.—Society of Arts, 8.
—— Pharmaceutical, 8.
Thursday.—Royal Institution 3. "On Historical Portraiture," Mr. G. Scharf.
—— Royal, 8½.
—— Chemical, 8. "Action of Oxidising Agents on Organic Compounds, &c.," Messrs. Wanklyn and Chapman. "On Chloranil, and on the Action of Nitric Acid on Picramic Acid," Dr. Stenhouse. "On Hydride of Aceto-Salicyl," Mr. W. H. Perkin.
—— Royal Society Club, 6.
Friday.—Royal Institution, 8. "On some of the Conditions of Menta Developement," W. Kingdon Clifford, Esq., B.A. Cantab.
—— Geologists' Association, 8.
Saturday.—Royal Institution, 3. Professor Roscoe, "On the Non-Metallic Elements.

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3518. A. T. Carr, Winkleigh, Devonshire, "An improved manure."—December 11, 1867.

3544. J. H. Johnson, Lincoln's Inn Fields, "Improvements in the manufacture of artificial fuel."—A communication from A. F. P. A. G. Decamps, T. de Joly, and F. F. Chollat, Paris.—December 13, 1867.

3559. J. Hargreaves, Appleton-within-Widnes, Lancashire, "Improvements in the manufacture of soda and potassa."

3566. A. M. Clark, Chancery Lane, "Improvements in the extraction of ammonia from fermented and other liquids, and in the regeneration of the agents used in such extraction."—A communication from A. Coste, and L. T. de Rosnay, Boulevart St. Martin, Paris.—December 14, 1867.

3573. W. Huskisson, Swinton Street, Gray's Inn Road, Middlesex, "Improvements in the manufacture of soda and other aerated waters, and in the manufacture of aerated bread."

3574. J. Dawson, Greenock, Renfrewshire, N.B., "Improvements in treating sugar syrup."

3586. W. Ross, Grove Street, Walworth, and A. Long, Aylesbury Terrace, Walworth, Surrey, "Improvements in means for preventing and removing incrustation in steam boilers."—December 17, 1867.

3614. W. H. Richardson, Glasgow, N.B., "An improved apparatus to be employed in the manufacture of iron and steel."—December 19, 1867.

NOTICES TO PROCEED.

2292. W. R. Dawson, Great Saint Helen's, London, "Improvements in the preparation of titaniferous iron sands for smelting."—Petition recorded August 9, 1867.

2305. R. Girdwood, Edinburgh, Mid Lothian, N.B., "Improved composition to be applied to sheep and other animals, for the purposes of destroying vermin, and parasitical life thereon, and form protecting them therefrom."—August 10, 1867.

2308. C. D. Abel, Southampton Buildings, Chancery Lane, "An improved method or process for removing sulphur, phosphorus, and other impurities from iron, steel, and other metals."—A communication from J. F. Bennett, Pittsburgh, Penn., U.S.A.

2314. A. McDougall, Manchester, "Improvements in the extraction and separation of the sulphur contained in products resulting from the alternate exposure of certain metallic oxides to gases containing sulphuretted hydrogen, and to oxygen."—August 12, 1867.

2344. J. T. Way, Russell Road, Kensington, Middlesex, "Improvements in treating phosphate of lime for the manufacture of manure, and for other purposes."—August 14, 1867.

2377. J. Hooker, Oberstein Road New Wandsworth, Surrey, and F. Braby, Euston Road, Middlesex, "Improvements in fire lighters, also applicable for fuel generally."—August 19, 1867.

2410. J. G. Marshall, Leeds, "Improvements in solvent or detergent processes."—August 22, 1867.

2436. E. Sonstadt, Manghold, Isle of Man, "Improvements in the treatment of sea-weed for obtaining valuable products from it."—August 26, 1867.

2522. F. Versmann, Ph.D., High Street, Stratford, Essex, "Improvements in the manufacture of varnishes."—September 5, 1867.

2541. J. Whitham, Kirkstall Road, Leeds, "Improvements in machinery for puddling, and in puddling and other furnaces."—September 7, 1867.

2546. W. E. Gedge, Wellington Street, Strand, Middlesex, "Processes of extraction of the colouring matter of indigo from the waste textile fabrics which contain it."—A communication from C. Bernard, P. Scheurer, and J. B. Tempé, Colmar (Haut Rhin), France.

2549. F. Tolhausen, Boulevart Magenta, Paris, "An improved process and apparatus for instantaneously disinfecting fecal and manuring matters, improving the same, and also rendering them fit for feeding domestic animals."—A communication from L. J. B. A. Lemoine, and A. M. Turrell, Paris.—September 9, 1867.

3248. J. Swindells, Kegworth, Leicestershire, "Improvements in the process of, and in apparatus employed in treating and separating minerals, earths, and other substances, when ground or pulverised."—November 16, 1867.

3384. J. Baylis, Durdham Down, Bristol, "An improved chemical preparation or compound to be used in preparing mixed textile fabrics for dyeing or colouring."—November 28, 1867.

3389. C. Albiser, Mincing Lane, London, "Improvements in the preparation of sulphate of magnesia applicable to the treatment of the crude potash salts of Stassfurt, and the refuse] from the manufacture of chloride of potassium."—A communication from J. Vorster, and H. Grüneberg, Cologne, Prussia.—November 29, 1867.

3440. J. Gjers, Middlesbrough, Yorkshire, "Certain improvements in the manufacture of cast steel and homogeneous iron."—December 3, 1867.

3469. P. G. L. G. Designolle, Rue de La Steine, and I. Casthelay, Rue Ste. Croix de la Bretonnerie, France, "Improvements in the manufacture of explosive and fulminating powders."—December 5, 1867.

3473. J. Durrans, Thurlstone, near Peniston, Yorkshire, "An improved material or composition to be employed for covering or coating the interior surfaces of moulds, crucibles, or ducts, previous to their receiving the molten metal in the process of casting, and for other purposes."—December 6, 1867.

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THE CHEMICAL NEWS.

Vol. XVII. No. 431.

ON SOME POINTS IN CHEMICAL GEOLOGY.

By DAVID FORBES, F.R.S., &c.

No. III. Dr. Sterry Hunt's Geological Chemistry.

In considering the mutual relations of the sciences of chemistry and geology, the student must always bear in mind which of these two sciences is to form the basis or starting-point for his inquiries, since this cannot fail to exercise an important influence on his reasonings and deductions.

In what Dr. Hunt calls my chemical geology, I have taken geology as my basis, and then endeavoured to apply chemistry, especially experimental chemistry, to the explanation of known geological phenomena.*

On the other hand, however, Dr. Hunt, in what may be termed his geological chemistry, starts from data purely chemical, and then looks round for geological instances to which these may be applied; thus, for example, starting from the fact well known to chemists, that a solution of carbonate of soda will precipitate carbonate of lime from a solution of chloride of calcium, he at once asserts that—

> "The whole of 'the calcareous strata, the marble and various limestones which we find on the earth's surface' have been precipitated from the ocean by a solution of carbonate of soda."

Again, observing that in the laboratory the reactions of the compounds of magnesia with carbonic acid under a dense atmosphere of that acid, might be used in facilitating the separations of the sulphate of lime (gypsum), or of the double carbonates of lime and magnesia (dolomites), he at once jumps at the conclusion—

> "That all the magnesian limestones and gypseous strata from the most ancient up to those of the tertiary period, were formed in a dense atmosphere of carbonic acid."

In the face of these assumptions, I contend and feel confident the geological world will support me in believing, that no geologist whosoever if applying the study of chemistry to the explanation of the phenomena of his science could by any possibility ever have arrived at such sweeping generalisations.

When the safety of Rome was endangered by the victories of Hannibal, the advice of Scipio to the Romans was to save Rome by attacking Carthage; and the communications of Dr. Hunt contained in the Chemical News of January 17th, and the *Geological Magazine* of February 1st, evidently prove that he is determined to pursue a similar course, yet I trust with a very different result, since in the present case I imagine that the forces at command will be found quite adequate for offence as well as defence.

In this discussion, however, much more trouble is likely to be caused to me by the method in which Dr. Hunt carries on his scientific warfare, and which seems to partake of the character of the country in which he resides, where the Indian system used to be to worry out the enemy by skirmishing, but never to attack strong points; and the history both of scientific discussion as well as of nations, shows how very effective such a plan of operations may prove even in the defence of a very weak cause.

For this reason, therefore, I have considered it prudent to keep the main points under consideration as prominently in view as possible, and not to allow the discussion to become so diffuse as to risk losing sight of them, which I fear the reader of Dr. Hunt's communications may be likely to do; acting on this determination, therefore, I have in my reply to Dr. Hunt's paper in the Chemical News, given a plain and concise statement of the points (numbered 1 to 9) in which I have presumed to differ from Dr. Hunt's opinions and as I now find nothing in his subsequent communication to the *Geological Magazine* of February 1st, which could in any way tend to shake my previous conviction as to the unsoundness of these points, I must be content to wait until Dr. Hunt may condescend to bring forward further evidence in their defence.

If now, however, after a perusal of Dr. Hunt's paper in the February number of the *Geological Magazine*, it is compared with the text of his previous communication in the Chemical News of January 17th, it will be perceived, as the editor of the *Geological Magazine* has already observed, to be to a great extent the same, and in many parts even *verbatim*; and remembering the puerile accusation brought against me by Dr. Hunt, that I "for some unknown reason withheld from the readers of the Chemical News" matter which I published in the pages of the *Geological Magazine*, it really is amusing to observe that Dr. Hunt in like manner has reserved for the readers of the *Geological Magazine* several most interesting observations which probably he may have considered (and with some reason also) as beyond the capacity of the chemists who patronise the Chemical News; as, for example, the following lucid expositions:—

> "As for the noble metals, whose compounds with oxygen are decomposed at elevated temperatures, their great volatility as compared with earthy and metallic oxides would keep them in the gaseous form till the last stage of precipitation of earthy oxidised matters, when by far the greater part of the globe was probably solidified. Hence we now find them in the earth's superficial crust."

And a little further on, he adds:

> "We cannot conceive anything else than the production of a homogeneous oxidised silicated mass, upon which at a late period would be precipitated the noble metals."

Chemists will not require any comments upon the above, but as they have been accustomed to regard some of the noble metals, platinum for example, as amongst the most refractory bodies known, they will be interested in Dr. Hunt's discovery of their great volatility at heats below which silicates solidify at, as well as the information that the extreme refractory nature of the other metallic oxides had been so completely demonstrated, since some of them at least, as lead, bismuth, antimony, molybdenum, &c., have not been hitherto so considered.

Geologists, however, will not all feel convinced by Dr. Hunt's mere assertion, that the noble metals have from the beginning been in the earth's superficial crust, precipitated on to it from the skies like Jupiter's golden rain, but may also be inclined to believe that they may possibly have been carried up from below.

By a curious coincidence my answer to the criticisms of Dr. Hunt, which appeared in the following week's Chemical News, is also to be found in the *Geological Magazine* of Feb. 1, in which Dr. Hunt's second communication appeared, and I was glad to find that had I even been previously acquainted with the contents of this latter paper, I would not materially have altered my remarks, although I should have added a few more words in reply to some minor points brought forward by Dr. Hunt, which did not appear in his previous one in the Chemical News.

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* Here it should be explained that Dr. Hunt, by his having some time back published, both in France as well as in England, an outline of his principles of chemical geology, has fairly laid himself open to having his views both criticised and disputed, whilst, on the contrary, Dr. Hunt's knowledge of my views on this subject appears to have been derived from sketchy allusions to my opinions scattered throughout the two papers in connection with this discussion contained respectively in the *Geological Magazine* of Oct. 1, and the Chemical News of Oct. 4, last year. Although his virulent onslaught might for this reason be considered hardly as altogether fair, I so far from objecting to it, am on the contrary truly thankful to Dr. Hunt for thus enabling me to strengthen any weak points, and for inspiring me with more confidence than before in the views on chemical geology since brought forward by me and now in the press.

The only important one now advanced is set forth in Dr. Hunt's courteous request for Mr. Forbes to explain "the intervention of water in all igneous rocks, which, as he declares, are outbursts from the still fluid interior of our globe."

The above words do not exactly express my views, since I maintain that igneous rocks have their source in some *reservoir or reservoirs* of still fluid matter in the earth's interior; and I see no difficulty in explaining, by the action of capillarity and heat, the infiltration of the requisite amount of water for the supply of such a source.

Not wishing, however, to accuse Dr. Hunt of "unfamiliarity with geological literature," to use his own words, I could not suppose him ignorant of the writings of Daubrée, whose labours in the field of experimental geology are well known, and it seemed strange that Dr. Hunt should have overlooked the fact that this question had been fully answered by this gentleman, whose words are—"En résumé sans exclure l'eau originaire et en quelque sorte de constitution initiale, que l'on suppose généralement incorporée aux masses intérieures et fondues, M. Daubrée est porté à conclure de l'expérience ci dessus relatée, que l'eau de la surface pourrait, sous l'action combinée de la capillarité et de la chaleur descendre jusque dans les parties profondes du globe."

Always preferring, when possible, a reference to fact or experiment than to authority, I would advise Dr. Hunt, in order to form a conception of such strange action, to examine a common Gifford or other injector used to supply feed water to a high pressure boiler, and he will soon perceive how it is possible that the very forces which otherwise would prevent the entrance of the water into the boiler can become the very means of forcing it in.

Dr. Hunt next asks me to remember "that the oldest known series of rocks, the Laurentian, consists of quartzites, lime-stones, and gneiss, evidently of sedimentary origin, and derived from still older sedimentary rocks. When I was in Canada, what little I did see of the Laurentian rocks, did not at all prove to me that they had been derived from still older *sedimentary* rocks, but on the contrary, whilst believing that the Laurentian and quartzites were of metamorphic sedimentary origin, and that the lime-stones were of metamorphic organic origin, I inclined to the conclusion that the materials out of which they had been reconstructed had most probably been the debris of still older igneous rocks, a view which I have maintained since 1854, with regard to some of the analogous Norwegian rocks, which I understand Dr. Hunt claims as Laurentian.

To refresh my memory, however, I have read over the description of the mineral characters of these rocks contained in the report of the geological survey of Canada, pp. 24-29, but can find therein no evidence whatsoever to the contrary, and therefore without disputing the correctness of Dr. Hunt's assertions as to points where he ought at least to be at home, I would ask whether this statement is founded on facts or hypotheses.

Dr. Hunt then devotes a whole page to what appears to be an inquiry as to who first showed that water played a part in igneous action, a subject which may be of personal or historical interest, but which is quite unconnected with the questions at issue, for in the consideration of nature all geologists will persist, notwithstanding whatever Dr. Hunt opines to the contrary, in regarding igneous action as volcanic action, and volcanic action as igneous action, nor can they imagine for a moment that any person except one who never had seen a volcano in eruption could be blind to the evidence of his senses, and deny the co-operation of vapours and gases in volcanic action.

That the results of Mr. Scrope's admirable researches should have been discredited, ridiculed, and declared unchemical, should be a warning to chemists in future not to hazard such opinions without having studied them in the field as well as in the laboratory.

As Dr. Hunt now brings forward the question of the density of quartz, it may be as well to remind him that all arguments based upon such data must necessarily be invalidated by the fact that the specific gravity of quartz crystals out of true volcanic lavas is found to be 2·6, or the same as the quartz in granite, whilst Mr. Sorby's microscopical examination of the quartz found in recent lavas conclusively proves that it can have crystallised out of the molten mass, and not necessarily, as Dr. Hunt would have us infer, merely been entangled from the débris of originally sedimentary strata.

Having long occupied myself with the application of the microscope to geology, and having repeated many of Mr. Sorby's experiments relating to this subject, I do not even think it necessary to contradict Dr. Hunt when he accuses me of not understanding Mr. Sorby's views, being quite content with that gentleman having expressed himself most decidedly to the contrary. Whilst I now recommend Dr. Hunt to commence the study of microscopic geology, I can at the same time well imagine his being disconcerted when on opening the February number of the *Geological Magazine*, in which his own paper appeared, he at the same time found a few lines from Mr. Sorby quite sufficient to annihilate the deductions he had so elaborately arrived at from a study of that observer's memoirs with a view to make them serve his own purposes.

All the other points have already been considered in my paper in the Chemical News, and I would only remark with regard to Dr. Hunt's criticisms upon my chemical geology, that it is probable that some of them would not even have been brought forward by Dr. Hunt, had he waited until an outline of these views, now in the press, had appeared instead of selecting for attack disjointed fragments or sentences apart from their context; thus for example, in the case where he accuses me of being ignorant of the laws of diffusion: he would have found my opinion expressed as follows:—

"Whilst on the one hand the zones formed in the earth are considered to have possessed a somewhat stable or permanent character, those present in the atmosphere would on the contrary be the reverse, for no sooner had the gasiform products forming them, by in the first instance obeying the impulse of gravity, and so overcoming the counteracting tendency of the laws of the diffusion of gases, than these latter would assert themselves, and in process of time entirely obliterate this arrangement."

And again:—

"As before stated, this arrangement would gradually be obliterated by diffusion, but as the element of time is one of vital importance in considering the effects of diffusion, it is imagined that before being obliterated, this arrangement may still have had considerable influence in modifying the chemical reactions which took place at this period in the earth's history."[†]

Dr. Hunt, whose knowledge of the laws of diffusion does not seem to include any appreciation of the importance of the element of time in their consideration, might just as well maintain that a lump of sugar could not reach the bottom of a tumbler of water because sugar will dissolve in water.

As Dr. Hunt seems to have great respect for authorities on each subject, I will have great pleasure in submitting the question as whether my proposition is invalidated under these circumstances by the action of laws of diffusion to Mr. Graham, the great expounder of these laws, and abide by his verdict.

In the discussion of new views, more, however, is required than mere quotations from old authorities, what is specially required are facts and experimental evidence; it must also be rememembered that much depends upon the mode in which authorities are made use of in such discussions, since it is often an easy matter to select passages or disjointed fragments from the published works of authorities which may appear to support almost any view which may be taken of a subject under consideration.

[†] It must be remembered that these great bodies of gases and vapours are supposed to be the results of a general and simultaneous act of chemical combination *in situ*, and not to have been slowly gathered together from the realms of space.

Dr. Hunt, whose papers consist in greater part of a compilation of references to numerous authorities, from the time of Thomas à Kempis down to that of Sterry Hunt, seems to be quite aware of this fact, as an instance or two will testify.

Thus, when Dr. Hunt quotes Hopkins in support of his views as to the consolidation of the molten sphere, he takes good care not to inform his readers that Hopkins distinctly declares his opinion that the exterior was not the last to solidify, but would have consolidated and formed a crust before the interior had become entirely solid, a view which I have adopted on his authority, and which is diametrically opposed to Dr. Hunt's opinion, that— .

> "The surface of the earth immediately previous to its entire solidification was "a liquid bath of no great depth surrounding the solid nucleus."

Again, although he finds it convenient to quote Forchammer in reference to some minor points quite beyond the limits of the present discussion, he seems to be quite unaware of the fact that the idea of the saline crust of chlorides, &c., which he ridicules my having adopted, was long before propounded by Forchammer, who first made the calculation that the quantity of chloride of sodium in such a crust would have been sufficient to have clothed the entire sphere with a coating of salt some 10 feet in thickness.

And yet, again, when he refers to Sorby's experiments as corroborating his views, as for example that quartz cannot be a volcanic product, *i.e.*, a product of igneous fusion in nature, his deductions are at once put to rout by the few lines from Sorby himself brought forward in my last communication to the Chemical News.

On the other hand, after a full consideration of the various memoirs of Hopkins, Forchammer, and Sorby, along with a careful repetition of many of their experiments, I have failed to discover any point inconsistent with the views I have advanced, and I am further enabled to find much evidence in their favour in the writings of Daubrée, Durocher, Bunsen, Phillips, and other eminent scientific men whose opinion Dr. Hunt evidently considers as quite beneath his consideration.

To prove that it is better to stay at home in one's laboratory than to travel wide and far in order to study nature's operations in the field, as is considered necessary to the geologist by Sir Charles Lyell and other eminent men, Dr. Hunt quotes, from Thomas à Kempis, "the wise saying passed into a proverb among churchmen"—that "those who make many pilgrimages rarely become saints."

In this we are quite of accord, since it is well known that a knowledge of the world acquired by travel is the best antidote to bigotry or one-sided opinions. What we require are geologists, not saints, and although it may be that in Canada geologists are esteemed in proportion to their saintly pretensions, experience on this side the Atlantic does not tend to prove that any of the natural sciences have been as yet much advanced by the labours of the would-be-saintly portion of the community.

As I have previously explained, I was induced to enter into this discussion (which I am still confident will do good to science by energetically ventilating some obscure points) by the special invitation conveyed in writing from Dr. Hunt "to have a friendly fight;" but I now find, if I may judge from the style of that gentleman's communications to the Chemical News and *Geological Magazine*, that his idea of scientific warfare consists in an attempt to overwhelm and crush his opponent with sneers and countless accusations of incompetency and ignorance :[‡] ignorance of chemistry, of geology, of petrology, mineralogy, microscopy, literature of the subject, &c., &c., &c., whilst at the same time he does not fail to herald in his own views as what might be termed the quintessence of the combined "results of modern investigations in physics, chemistry, mathematics and astronomy." Would it not have been more prudent, as well as more becoming, to have left to our readers the task of forming their own judgment upon the evidence on both sides brought before them in the course of this discussion.

Having no pretensions, either to being a saint, nor like Dr. Hunt, to be versed in saintly lore, I cannot quote Thomas à Kempis, yet I can nevertheless follow his example and wind up with an old quotation; for even at the risk of appearing still more uncourteous, I really cannot resist the temptation to remind him of the old saying, passed into a proverb amongst laymen, that "curses, like chickens, come home to roost."

[‡] Dr. Hunt does not content himself with mere accusations of ignorance, for when disputing my statement that the reactions of the compounds of magnesia with carbonic acid in an artificially compressed atmosphere of that acid, had long been employed in manufactures,—he uses the words, "here it becomes difficult to admit the plea of ignorance which suggests itself for most of Mr. Forbes's errors and mis-statements." I may merely add, that since the appearance of Dr. Hunt's paper in the Chemical News of Jan. 17th, I have received various communications from chemists and others connected or acquainted with this manufacture, not only offering to supply facts in full corroboration of the truth of my assertion, but also directing my attention to a long expired patent (No. 9102. 1841) of the late Mr. Pattinson, of Newcastle, in which these very reactions are distinctly embodied.

ON THE USE OF THE
SPECTROSCOPE AND MICROSPECTROSCOPE
IN THE DISCOVERY OF
BLOOD STAINS AND DISSOLVED BLOOD,
AND IN PATHOLOGICAL INQUIRIES.

By W. BIRD HERAPATH, M.D., F.R.S.

The discovery of and recognition of blood stains, and more especially of human blood, has been a problem which has long baffled the skill of the chemist and the more highly trained medico-legal eye of the microscopist, and any means by which our medical jurists can lessen the difficulties, and facilitate the inquiry, must be hailed as a boon by all scientific observers. Hitherto the chemical difficulties of the question have been the greater in the inverse proportion to the quantity of stain, and many minute and perfectly evident spots would even evade recognition by the test tube in consequence of the smallness of their size, or the disadvantages of their position. Whilst the microscope would also fail in their detection if from any peculiar circumstances the globules could not be safely and securely removed from the tissues which were under careful examination; independently of which the chemical and physical changes induced in the characters of the blood globules by the various menstrua employed in their removal, rendered recognition by micrometrical admeasurement a very doubtful and uncertain operation.

When blood globules are to be discovered floating in a saline fluid, such as urine, saliva, or the generality of mucous discharges, the microscope will readily detect their presence; and should the density of the fluid be very closely equal to the specific gravity of the serum of the blood, scarcely any change in their physical characters would occur, and it would then be possible to determine their exact form and size, and render their probable source a question of easy solution; but when the blood has been dried and long exposed to the air, it is no longer easy to reproduce the blood globules in their pristine form and optical characters, as the various media employed to dissolve the clots act on the globules with more or less celerity. It is usual to employ either solutions of cane or grape sugar, or mixtures of glycerine and distilled water having a density of 1·030°. Some observers have employed saline solutions for this purpose, others have used a strong solution of arsenious acid in distilled water; the objects which each have in view being the removal of the blood discs, and the non-alteration of their physical characters. If the action of the solvent or medium, from its deficient density or peculiar chemical properties, has resulted in a destruction of the blood globules and a solution of the colouring matter, the *microscope* would no longer either recognise its mammalian character or even assure us of the presence of blood.

In this condition of the enquiry the chemist alone, by the employment of tests, could decide the question of the presence of dissolved hæmatine, and would chiefly rely on the action of heat in coagulating the albumen and destruction of the colour; whilst upon another portion of the fluid he would assure himself that ammonia would not produce any great change of colour, thus deciding the non-vegetable character of the colouring matter. But during the past two or three years an addition has been made to our optical instruments in the aid which we have obtained in the recognition of various substances by the effects which they have on the absorption of different portions of the spectrum, and we have various forms of spectroscope according to the purposes for which they were intended.

The first invented spectroscope was a very efficient but cumbrous instrument, and astonished the world by the discovery of four new metals in consequence of the remarkable peculiarities of their coloured flames, and thallium, cæsium, rubidium, and indium have been thus isolated from other bodies, and added to the list of elementary bodies. Shortly afterwards Professor Stokes introduced a modification of this instrument, which enabled liquids and coloured fluids to be submitted to the same mode of testing them by their absorptive spectra, and on the table is one which I have long employed for this purpose, a more powerful and efficient instrument than that recommended by him for these experiments. In this instrument, essentially a direct vision or Hofmann's spectroscope, the liquid to be examined is placed in a small test-tube, and that is held in a clipped spring, which supports it during the examination, whilst a bright light is transmitted through the liquid previous to its analysis in the spectroscope,—the spectrum showing various bands of absorption in well-marked optical liquids, some of the most beautiful of which are certainly weak solutions of permanganate of potassa, and dilute solutions of cruorine and hæmatine. In the first case five dark bands are seen in the green part of the spectrum, and in that of blood two sharply defined black bands are seen, one in the green, and another on the border of the orange ray. The intensities and positions of these bands vary according to the age of the blood stain, and result from the alteration in the colouring matter of the blood, from the effects of drying, and from exposure to air.

The stains when old have a much less decided or evident absorption, the bands are weaker, and an additional band of a diffuse character is found in the red ray. But it does not appear to be possible to form any positive, or accurate, opinion on the age of blood; from various observations it has been ascertained that these changes take place with more rapidity under some circumstances than in other apparently similar cases.

In all optical experiments on blood, it is necessary to use *excessively* dilute solutions of the colouring matter; otherwise the fluid is absolutely opaque to light—or if it transmit any light at all, nothing but the extreme red rays are observed. When still more dilute, the blue end of the spectrum is quite absorbed, and so are two bands in the green, and occasionally, also, one in the red. These optical properties of blood were first pointed out by Hoppe (*Virchow's Arch.*, 1862, vol. xxiii. p. 446), and subsequently by Professor Stokes (*Proceedings of the Royal Society* 1864), and Mr. Sorby (*Quarterly Journal of Science*, 1865.)

Professor Stokes has investigated the effects of different chemical reagents upon the colouring matter of blood (*Proceedings* of the Royal Society, 1864, p. 355, *et seq.*) and he has arrived at a very intelligible solution of the various phenomena exhibited by this remarkable substance, and has come to the conclusion that arterial and venous blood in the recent fluid condition contains a substance called cruorine, which like indigo is capable of existing in two different states of oxidation and colour. That in arterial blood, scarlet cruorine is the form in which it is found, and in this condition very dilute solutions produce two very sharply defined black bands of absorption, one close to and parallel with the sodium line D, and is the more intense of the two; whilst the second is found in the green ray about the breadth of the previous band distant from it.

On submitting this scarlet cruorine to deoxidising agents to a moderate extent, the cruorine becomes the deoxidised or purple cruorine, and then the solution is light or deep purple according to its degree of concentration.

Examined by the spectroscope in this condition, only one deep broad band of absorption is found, which commences about the solar or sodium line D, and then passes onwards to the green, absorbing the whole of the yellow and part of the green band of the spectrum. It is remarkable that upon shaking up a dilute solution of scarlet cruorine with an atmosphere of carbonic acid the fluid does not exhibit the appearance, or spectrum of venous blood. It is evident therefore that the blue colour of venous blood is not produced by the presence of carbonic acid in solution, but to a *reducing action* in the capillaries analogous to that of other reagents, whilst the influence of sulphide of ammonia, sulphuretted hydrogen, or the hydrated protoxide of iron, or the protochloride of tin, or the peculiar deoxidation of arterial blood due to the changes going on in the systemic circulation, are all instances in which such a deoxidation or reduction has been in action. A dilute solution of scarlet cruorine set aside in a full closely corked phial, or with very little air, will shortly pass by spontaneous deoxidation to the purple cruorine, and will then exhibit all the optical phenomena of this peculiar substance, but resumes its scarlet colour by agitation with air. Professor Stokes says that of all reducing agents, an ammoniacal solution of protochloride of tin, (previously treated with sufficient tartaric acid to prevent the precipitation of oxide of tin), is the most efficient reducing agent, and as it is colourless it does not interfere with the spectroscopic appearances. He says that when a few drops of this solution are added to a solution of scarlet cruorine, the latter is presently reduced and we have the spectrum of purple cruorine. If the solution be now shaken up with air, the cruorine is reoxidised to the scarlet form. On standing a few minutes it again becomes reduced, and the solution may be made to go through these changes repeatedly until all the tin has passed to that of complete oxidation.

But when blood or scarlet cruorine is treated with an *excess* of deoxidising material, or has become changed by long exposure to air or by drying, or by the effect of sulphurous and some other acids, the colouring matter becomes brown and more insoluble in water. It is in fact then changed into *brown hæmatine*, which has very different optical properties from that of either scarlet or purple cruorine. The two dark bands of absorption are still found, but have become very faint, and much less sharp in outline, whilst a third dark band is seen in the red ray; of course, on the less refrangible side of the solar or sodium line D. This change, when produced by age and exposure, is sometimes months in being fully accomplished, and is only well marked on the appearance of the dark band in the red ray.

Now just as cruorine can exist in two different forms, so can hæmatine; and we have either the brown or the red hæmatine, the latter being produced by deoxidising the brown hæmatine by some reducing agents, as hydrated protoxide of iron. Then two bands of absorption occur, as in scarlet cruorine, but capable of being readily distinguished from those by their position and different degrees of intensity.

(To be continued.)

METHOD FOR THE

DETERMINATION OF SILICON IN IRON AND STEEL.*

By V. EGGERTZ,

Professor at the School of Mines, Fahlein, Sweden.

(Concluded from p. 101.)

The oxide of iron is easily dissolved in the heat of a water-bath. The silica is again thrown on a filter, washed, dried, ignited, and weighed. 0·016 gramme of silica answers to each 0·001 gramme of silica when 3 grammes of iron have been used in the analysis. To ensure the purity of the silica, it may be mixed in a platinum crucible with ten times its weight of pure fluoride of ammonium, diluted with water to the thickness of syrup. The water must be evaporated on a water bath, and the crucible heated, with a cover on it, by a gradually increasing heat over a spirit-lamp to a full red. If nothing is left in the crucible, the silica was pure, and has passed off as silicon fluoride; but, if any thing remains, the operation with fluoride of ammonium must be repeated until a constant weight is obtained. When iron contains tungsten, for instance, some tungstic acid is formed, and this accompanies the silica for the most part, being dissolved by the soda solution, but not volatilised by the use of fluoride of ammonium. Vanadic acid also accompanies the silica, behaving as tungstic acid Instead of using fluoride of ammonium, it is preferable to use hydrofluoric acid, with which the silica is moistened, and the evaporation is conducted on a water-bath. 0·1 gramme of pure silica obtained from analysis is easily dissolved by 2 c.c. of hydrofluoric acid (of the strength that 2 c.c. of it are neutralised by 1·5 c.c. of a saturated solution of ammonia 0·95 sp. gr.). When using hydrofluoric acid, getting it on the hands or exposure to the evaporating gas must be carefully avoided. The mass left on the filter from the soda solution may be composed of—besides graphite—slag, oxide of iron, oxide of titanium, &c. (but not copper, at least when the iron does not contain more than 1 per cent); this is dried, ignited, and weighed. The method of separating oxide of iron and slag, when the iron or steel contains both these, is not yet known. If the composition of slag were always alike (which it is not), it would be easy to calculate its amount from either the silica or oxide of iron obtained in the analysis. In a piece of Bessemer iron very red short (that is, it could not be bent at a white or yellow heat without being broken), which contained no sulphur, by several experiments 0·3 per cent of oxide of iron has been obtained, and only traces of silicon. After ignition, the oxide of iron may possibly be found as sesquioxide. The amount of oxygen, in case that the red shortness is due to this, as it probably is, amounts to less than 0·1 per cent.

When the iron or steel for analysis contains titanium, a part of this substance follows the slag in the form of titanic acid. If such is the case, this must be melted with ten times its weight of acid sulphate of potash, by which it is dissolved; the mass is dissolved in cold water, and the solution precipitated by boiling; the weight is determined, and subtracted from that of the slag. This ingredient has not, however, been found in bar iron or steel in such a quantity as to merit special attention.

Regarding the determination of silicon in cast steel where only a trace of slag is found, the method given below for cast iron may be employed; but 3 grammes at least ought to be taken for each experiment, and the acids for solution in proportion.

In experiments conducted at the Mining Institution for the determination of silicon and slag in bar iron and steel, the amount of silicon has generally varied between 0·01 per cent and 0·1 per cent; but in two sorts of good cast steel from Krupp's it has amounted to about 0·3 per cent. Slag in cast steel has been found only in traces, but in another case it amounted to 0·2 per cent; in good iron wire, prepared from bar iron, converted in a refinery hearth, from charcoal pig iron, 0·33 per cent; in puddled iron (armour plate), from 0·75 to 3 per cent; and in an English iron rail, to 4 or 5 per cent.

For the determination of silicon in cast iron, in which no finery slag is found, and only exceptionally blast-furnace slag, the following method has proved suitable; 2 grammes of iron, which has passed a sieve with holes of a diameter of $\frac{1}{25}$ in. at the most, is put into a beaker of 100 c.c. capacity, containing 30 c.c. of hydrochloric acid, sp. gr. 1·12. The beaker is covered with a close-fitting watch-glass, heated without delay, and the liquid kept at a gentle boiling for half an hour.

All the carbon chemically combined with the iron is separated from the liquid in the form of an ill-smelling hydrocarbon gas, by which operation a disadvantageous formation of humus and oxide of iron is prevented (in case that the solution should be required for further researches).

If the carbon formed in the solution is left in contact with the air some minutes before the boiling is begun, it undergoes such a change that it cannot afterwards be decomposed into gas and evaporated; if necessary, some hydrochloric acid is added, and the solution evaporated on a water bath, until the smell from hydrocarbon gas has ceased. If the graphite in the iron is to be determined at the same time, it is placed, as well as the silica, on a filter previously dried at 95° or 100°, and weighed; well washed with hot water containing 5 per cent nitric acid, again dried, weighed, and ignited in a porcelain crucible. By deduction of the weight of silica and of the filter ash, the amount of graphite is determined. (It must be observed that the silica dried on a filter contains 6 per cent water, or only 94 per cent silica.) If, for instance, the filter weighs 0·125 gramme, and its ash 0·001 (the combustible substance being 0·124 gramme) and the filter + graphite + silica 0·182 gramme, and the residue after ignition 0·025 gramme (0·001 gramme of this is filter ash), the weight of the silica (0·024 gramme) is, after the drying, 0·0255 gramme, and thus the weight of the graphite becomes $0·182 - (0·124 + 0·001 + 0·0255) = 0·0315$ gramme. To the solution, after the separation of graphite and insoluble silica, is added 4 c.c. nitric acid, 1·2 sp. gr., and evaporated to dryness. The further proceedings are the same as previously described for the determination of silicon. If it is intended to determine only the silica, the whole solution is evaporated to dryness immediately after boiling. When the silica is red, strong hydrochloric acid is added, as previously described. If the silica is contaminated with titanic acid, vanadic acid, or tungstic acid, it is operated upon with fluoride of ammonium or hydrofluoric acid, as previously mentioned, whereby the silica is evaporated and calculated by loss. By the above method of dissolving iron in hydrochloric acid, the silicon changes, without evaporation, for the most part, to insoluble silica, which may be filtered and determined. Sometimes a very unimportant part is dissolved, especially if the boiling has been short.

When iron is dissolved in hydrochloric acid without heating (white cast iron is very difficult to dissolve in this way), a still less portion is dissolved, and generally so little that it may be neglected for practical purposes.

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* From *Engineering*, July 24, 1868. Translated by C. P. Sandberg.

The washing is performed with hot water containing nitric acid, as previously described.

When the iron is dissolved in nitric acid, a great deal of silica enters into solution.

The different sorts of cast iron appear to be slightly different in this respect. In dissolving cast iron with heat, in very diluted sulphuric acid, a great deal of silica is dissolved, but very little when the water is the least possible; as the water evaporates, the silica settles and becomes insoluble. The method given below rests upon these circumstances, and has proved very satisfactory, and by this the taking away of the acid is avoided, which is both necessary and troublesome when using hydrochloric acid with heat. The amount of silicon has, according to both methods, turned out alike. Traces of silica are always found left in the solution and wash-water. Regarding the determination of silicon in iron, it should be observed that only such vessels may be employed as are unacted upon by the reagents used in the analysis, as otherwise an undue proportion of silicon may be obtained.

Two grammes of cast iron which have passed a sieve of 0·2 of a line, are shaken by small portions at a time into a beaker of 100 c.c. capacity. In this beaker has been previously put 18 c.c. of water with 3 c.c. pure sulphuric acid of 1·83, or 15 c.c. sulphuric acid of 1·23 p. gr. with 6 c.c. of water.

The beaker is covered with a watch-glass, and placed on a water-bath; if the graphite rises on the sides of the beaker, it is pushed down into the liquid by a glass rod. When the iron is dissolved, the watch-glass is changed, after being washed, for a paper cover, and the solution evaporated on a water-bath until no condensation occurs on a watch-glass held over the beaker; 30 c.c. of water are then added, and it is frequently stirred with a glass rod, whilst on the water-bath, until the white iron salt has completely dissolved. The insoluble mass is then thrown on a filter, washed with hot water containing 5 per cent nitric acid, 1·2 sp. gr. (in order to dissolve all compounds of iron) as long as an iron reaction is given with ferrocyanide of potassium. The filter, with its contents, is placed in a carefully tared porcelain crucible; it is then cautiously dried, ignited, and weighed. The silica contains 48 per cent of silicon, and its purity is examined by the method previously mentioned, when such is considered necessary. If the cast iron contains vanadium, this is obtained for the most part as a yellow-brown vanadic acid with the silica, from which it may be extracted by warm hydrochloric acid or ammonia.

When intending to determine at the same time the amount of graphite in the cast iron, the solution is treated, after the separation of the chemically combined carbon, by boiling, as previously described when dissolving the iron in hydrochloric acid. In determination of graphite the use of hydrochloric acid is preferable.

The greatest amount of silicon which has been found here in grey charcoal pig iron was 2·7 per cent., and in white (spiegeleisen) 0·8 per cent. The amount of silicon in pig from coke blast-furnaces is rarely more than 4 per cent. The least quantity of silicon in grey cast iron has been 0·2 per cent, and in white (spiegeleisen) it has not been less than 0·01 per cent. The amount has usually been from 1 to 2 per cent in cast iron suitable for the Bessemer process, about 1 per cent in good Franche Comté, and in pig iron for puddling about 0·5 per cent.

From many iron works have been obtained pig iron suitable for refining on the charcoal hearth, which contained about 0·2 per cent silicon; but from others a greater amount of silicon has been found in the same sort of pig iron, and it is generally presumed that different quantities of silicon require a different construction of the furnace, and a different method of working the refinery. It has been clearly proved by numerous experiments what a great influence the amount of silicon has upon the nature of cast iron, in being more or less easily refined, &c., and at the same time the great importance of paying more attention to its manufacture than has hitherto been done, in order to obtain cast iron, which, with regard to its silicon, may be suitable to the purposes for which it is to be employed.

The amount of silicon in iron of different degrees of hardness from the same charge of the blast furnace ought to be pretty well valued by the fracture, after some determinations have been made by analysis.

ON

HEAT AND COLD;

A COURSE OF

SIX LECTURES

(Adapted to a Juvenile auditory),

DELIVERED AT

THE ROYAL INSTITUTION OF GREAT BRITAIN,

(CHRISTMAS, 1867–8),

BY

JOHN TYNDALL, Esq., LL.D., F.R.S.

Lecture VI.

(Concluded from page 105.)

Reflection, refraction, and absorption of radiant heat.—The heat of the sun.—Visible and invisible rays.—Extraction of light from the rays of heat.

I have had occasion to say to you once or twice in these lectures that no body in nature is absolutely cold. All bodies are more or less hot. Even ice itself is a hot body compared with solid carbonic acid. In fact, ice would be quite competent to make a mixture of solid carbonic acid and ether boil, it being hot in comparison. All bodies are warm, and all bodies are emitting rays of heat. Here is a platinum wire in front of the table, such as we have already operated upon. At the present time that platinum wire is emitting rays of heat of a perfectly definite character. If I connect this wire with our battery you will observe our old experiment. You see the wire is heated to redness; it emits rays of heat, and also to some extent rays of light. Before the electric current passes the wire emits rays of heat which are incompetent to excite vision; but when I raise the temperature of the wire thus, by sending the electric current through it, what becomes of its old rays of heat which it emitted in this invisible state? They still maintain themselves, and they become much stronger, but they are still obscure. We mix, with the luminous rays of that wire, the obscure radiation that issued from it before the current made it incandescent. If I go on shortening the wire, as in an experiment we made in an early portion of these lectures, we find it gets brighter and brighter, but the rays it emitted before it became red hot at all are still mingled with the visible radiation. They exist, but they exist greatly intensified; so that the rays which issued from that wire before it became incandescent, are present, as well as the visible rays, but they are raised to a thousand times the intensity which they first possessed. They are still obscure, and have no power to excite vision, but they are, nevertheless, there with a thousand-fold their first intensity. Now I must try to separate before you these luminous rays from the obscure rays; and I must endeavour to operate upon the obscure rays so as to show you some effects that they can produce. I think you will understand the process by which this can be done. I have here a small concave mirror, and this I will place behind the electric lamp. We shall have an image of the carbon points of the lamp produced in that way, and I will throw that image upon the screen. We have now thrown upon the screen an image of the carbon points, whence issues the electric light. If I take another mirror, and converge the rays by it, I can give you a larger image, which, perhaps, will be better seen. Here is now a larger image of the carbon points produced in that way. The image is inverted. You see a considerable amount of light there, but Mr. Cottrell will now fill a vessel with an opaque liquid. The liquid which we use to obtain the opaque solution is called bisulphide of carbon: it is perfectly transparent; and here is the substance called iodine—very well known to many people. This bisulphide of carbon dissolves the iodine with great freedom, and the consequence is the production of this dark liquid, which is so wonderfully opaque that it would cut off the light of the sun at noon-day. Strange to say, it is the quality and property of this wonderful substance to entirely cut away the luminous or visible rays upon which depend the colours you saw on the screen, whereas it allows all the rays of heat to pass through. The liquid is opaque to light, but perfectly transparent to radiant heat. Mr. Chapman will place a lens in front of the electric lamp; and thus we obtain this beautiful convergent beam or cone of light tracking its way through the dust of the room towards the thermo-electric pile. Mr. Chapman will, when I tell him, place the cell containing this opaque liquid in front of the electric light. That will cut off bodily all the light, but still the spot where the pile will be placed will remain very hot. [The cell and pile were then placed in position.] You see that all the light is cut away; but you observe that the needle at once marches away, thus proving that although the light is cut off, the heat rays are left behind.

I want now to try and make these heat rays more evident to you still, and for that purpose I have placed within this camera an electric lamp similar to what I have just used; and behind the electric lamp I have placed a silvered mirror. This mirror will reflect the rays of light from the electric lamp, and will cause them to issue through this window which you see in front. This window is formed of rock salt. Rock salt is exceedingly transparent to the rays of heat, and also to the rays of light; and it is for that reason that I use that substance. I now obtain a convergent beam from the electric lamp. You see a brilliant cone of rays. Mr. Cottrell will now place the opaque solution in front. There it is, cutting off all the light, so that you see nothing. But now I bring this piece of platinum opposite the dark liquid; and observe what occurs. The platinum is raised to a red heat, in perfectly dark air. If, instead of platinum, I take some dry paper, and hold it in the focus of the dark rays, you see I can ignite that paper. The paper is set on fire. This ignition is caused by the invisible rays of heat issuing from the electric lamp. I now take a thick piece of metal, and hold it in the dark rays of heat: you see it is melted by the radiant heat, and drops down in a liquid state. I will now burn a piece of zinc here. There, you see the zinc is actually set on fire in a place where there was perfect darkness. The air where this zinc is set on fire is perfectly unwarmed. Nothing would be easier than to ignite a cigar in this way in perfect darkness. For instance, here is one which I will ignite. You see it is instantly set alight in a place where there is absolutely no light. You might put your eye where that platinum was raised to red heat. I have cautiously approached my eye to that burning focus that you saw there, and allowed the rays bodily to enter the eye, and could neither see light nor feel heat. The retina was perfectly dead to those very powerful rays. Sometimes we obtain the combustion of magnesium by these rays. Here you see we have that beautiful metal set on fire in a place where there were no light whatever—a space of utter darkness. I might set London on fire by means of these dark rays. I have here a glass jar containing oxygen gas, and into this jar I dip a piece of charcoal. I now bring the charcoal into the focus of the invisible rays of heat, and you see the charcoal is ignited by these dark rays, and burns brilliantly in this gas.

I want now to make one or two more experiments in connection with this subject. For this purpose I will take the same mirror which I have just used, and employ another camera which is at the end of the table. The mirror will be placed behind the light, and will reflect a beam of light along the table. Instead of allowing this beam to fall upon the audience and annoying you, I will catch it upon another mirror just as I caught the ray of light by the mirror near the ceiling in an experiment early in the lecture. I daresay many of you see the intense reflection here. There is a focus which would burn your fingers most fearfully if you put them there. I dare say we shall be able to inflame paper at that focus. There you see the paper instantly set in a blaze; and this blaze is produced not by the luminous rays, but by the dark ones. You might put a sensitive thermometer there, and have no result. It is only when the heat falls upon this paper that the heat is produced. We can burn zinc here as I did in the dark rays. You see the zinc is set on fire, and blazes up almost like a piece of paper. Here is a small vessel containing water, and I will place that in the focus of the rays. I now place another vessel of water in such a way that the light has to pass through it. This will intercept the dark rays which give the heat, though it does not sensibly interrupt the rays of light. At the present time the focus of rays falls upon the former vessel of water, without any effect whatever being produced upon it. I will now withdraw the vessel of water through which the beam passes before it reaches the mirror, and so allow the heat rays to pass, and you see the water in the vessel at the focus of the rays immediately begins to boil. After a time this water will be thrown into a state of violent ebullition. It is already boiling. This action is due not to the rays of light, but entirely to the dark invisible rays of heat of which I have been speaking.

I make these experiments for the purpose of bringing home to your minds the fact that we owe all our rivers, all our glaciers, and all our snow, entirely, or almost entirely, to these dark rays. The luminous or bright rays of the sun fall upon the tropical ocean, and pierce it to great depths: they are not absorbed; but the non-luminous rays—the heat rays of the sun—strike upon the tropical ocean, and they are absorbed very near its surface. It was by the absorption of the dark rays that the water was boiled in the last experiment. These dark rays of the sun which strike upon the tropical ocean, and are then absorbed, heat the surface of the ocean, and thus it is that all the moisture or evaporation is produced.

And now, I am sorry to say, we have come to the end of our task. I told you in the beginning that I wished very much to transfer the task of giving these lectures to somebody else, as I was so occupied that I could not make them what I wished to make them, and still I am not sorry that I undertook them. I am glad that I have come here, for it has given me great pleasure to meet you from day to day. You have made up by your attention for my defects in lecturing; and I have only to add that I thank you for that attention, and wish you from my heart a happy new year.

Preparation of Bromides.—A. Faust describes the following method for the preparation of bromides: Bromic sulphide is first prepared by mixing together 2 parts of sulphur (flower) and 24 of bromine; this is added to calcic hydrate, suspended in water, when the following reaction takes place:

$$2\,SBr_6 + 8\,CaO = 6\,CaBr_2 + 2\,CaSO_4$$

The filtrate is saturated with carbonic anhydride, concentrated, and mixed with twice its bulk of alcohol. After a few days the solution containing pure calcic bromide is filtered off from the calcic sulphate, and evaporated. From this salt any other bromide may be obtained by mutual decomposition.—(*Arch. Pharm.*, clxxxi., 216.)

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 21st, 1868.

Edward Schunck, Ph.D., F.R.S., &c., President, in the Chair.

"*Some Remarks on Crystals containing Fluid,*" by J. B. Dancer, F.R.A.S.

The author gave a brief history of the discovery of fluids in crystals, including Sir H. Davy's chemical experiments on the fluids and gases obtained from the cavities in quartz crystals; Sir David Brewster's discovery of the pressure cavities in the diamond, ruby, emerald, amethyst, chrysoberyl, &c.; the existence of minute crystals in these cavities and the two new and remarkable fluids, which are immiscible, but sometimes found together in the same cavity,—one a liquid hydrocarbon, named Brewstoline, the other Cryptoline; his experiments and examination of artificial crystals deposited from aqueous solutions; his examination of the Koh-i-noor diamond and others in the East India Company's museum; and the geological speculations to which these discoveries gave rise. Mr. Dancer mentioned the experiments of his late father and others in producing artificial gems by intense heat, and stated that his own attention was drawn to this subject some twenty-four years since, by Sir David Brewster presenting him with a specimen of topaz containing fluid. Since that time he had examined a large number of crystals, of various kinds, from the collections of friends; and had found fluid in quartz from South America, Norway, the Alps, Ireland, Snowdon, and the Isle of Man; and in fluor spar from Derbyshire; this latter specimen contained a considerable quantity of fluid, which burst the crystal at 180° temperature.* He suggested the employment of the microscope as a valuable assistance in detecting spurious from real gems; very few of the latter are perfect, and the flaws and cavities are so distinct in character from those which are so abundant generally in artificial gems that very little experience is sufficient for the purpose. This mode of testing of course is limited to transparent crystals, but might be employed when the usual methods are not practicable. He also mentioned Mr. Sorby's (F.R.S.) discovery of fluid cavities in the quartz of granite, in the quartz of volcanic rocks, and also in the feldspar ejected from the crater of Vesuvius, and Mr. Sorby's method of determining the temperature at which various rocks and minerals are formed. At the conclusion of the meeting, crystals containing fluid were exhibited under the microscope, and the expansion of the fluid by elevating the temperature of the crystal whilst under examination.

Ordinary Meeting, February 4th, 1868.

Edward Schunck, Ph.D., F.R.S., &c., President, in the Chair.

Among the donations announced were several bottles of chemical products for the Society's collection, from Dr. F. Crace Calvert, F.R.S., &c.

The thanks of the Society were voted to Dr. Calvert for his valuable donation.

"*On Some Constituents of Cotton Fibre,*" by E. Schunck, Ph.D., F.R.S., &c., President.

It is generally supposed that cotton, when quite pure, consists entirely of woody fibre or cellulose, and that its composition is consequently represented by the formula $C_{12}H_{10}O_{10}$. It is certain, however, that in the raw state, as furnished by commerce, it contains a number of other ingredients, some of which occur so constantly that they may be considered essential constituents of cotton, viewed as a vegetable product. The object of the bleaching process to which most cotton fabrics are subjected is to deprive the fibre of these other ingredients and leave the cellulose behind in a state of purity. Notwithstanding the importance of an accurate knowledge of everything relating to cotton from an industrial point of view, the substances contained in it along with cellulose have never been subjected to a special chemical examination, and very little is consequently known about them. Persoz, in his *Traité de l'Impression des Tissus*, says that the woody fibre constituting the tissues of cotton, hemp, linen, &c., is not pure; it contains—1st, a certain quantity of colouring matter, which is more or less shielded from the action of decolourising agents by the bodies which accompany it, naturally or accidentally; 2ndly, a peculiar resin, natural to the fibre, insoluble in water and soluble with difficulty in alkalies, which plays the part of a reserve and protects the colouring matters inherent in the fibre from the action of the agents which ought to destroy and remove them; 3rdly, a certain quantity of fatty matter, of which a very small portion is peculiar to the fibre, the greatest part being derived from the operations of spinning and weaving; 4thly, a neutral substance, either flour, starch, or glue, which has been introduced by the weaver in sizing his warp; 5thly, inorganic saline matters, some of which belong to the fibre, while the others are derived from the water and the matters employed in the dressing of the warp. In the excellent article on Bleaching in the new edition of Ure's *Dictionary of Arts* there is a full account of these and other impurities of cotton fabrics, comprising all that was known at the time when the author commenced his examination.

The object which the author had in view in undertaking his investigation was to endeavour to throw a little more light on the nature of those substances which are contained in or attached to the framework of cellulose, of which cotton fibre mainly consists, and which are together with the latter produced by the plant. All foreign and extraneous matter introduced during the process of manufacture was therefore left entirely out of consideration.* The author has further confined his attention to those constituents of the fibre which are insoluble in water but soluble in alkaline lye, and are afterwards precipitated by acid from the alkaline solution. Whether cotton contains naturally any substance soluble in water, or which being originally insoluble is rendered soluble therein by the prolonged action of alkalies, is a question on which the author pronounces no decided opinion.

For the purpose of obtaining the substances which he proposed to examine the author employed cotton yarn, which he preferred to unspun cotton for several reasons, the principal being that yarn is comparatively free from mechanical impurities, such as fragments of seed-vessels, &c., while on the other hand, if proper care be taken, no impurity is added to those previously existing during the process of spinning. The yarn was boiled in an ordinary bleacher's kier for several hours with a dilute solution of soda ash. The resulting dark brown liquor, after the yarn had been taken out, drained, and slightly washed, was removed from the kier into appropriate vessels, and mixed with an excess of sulphuric acid, which produced a copious, light brown, flocculent precipitate, while the liquid became colourless. This precipitate was allowed to settle, the liquid was poured off, and after being washed with cold water to remove the sulphate of soda and excess of acid it was put on calico strainers and allowed to drain. A thick pulp was thus obtained, which when dried assumed the appearance of a brown, brittle, horn-like substance, translucent at the edges. In one experiment 450 lbs. of yarn, made from East Indian cotton, of the variety called "Dhollerah," yielded 0·33 per cent of the dried precipitate. In another experiment made with

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* After this Paper was written, Sir David Brewster informed the author that the fluid contained in crystals of fluor spar was water, and that the cavities burst at a temperature of 150°.

500 lbs. of yarn, spun from American cotton, of the kind called in commerce "middling Orleans," 0·48 per cent was obtained. The total loss sustained by yarn during the bleaching process amounts to about 5 per cent of its weight. Only a small portion of the matter lost is therefore recovered by precipitation of the alkaline extract with acid.

This precipitate formed more especially the subject of the author's investigation. It was found to consist almost entirely of organic substances, and of these the following were distinctly recognised :—

1. A species of vegetable wax.
2. A fatty acid.
3, 4. Colouring matters.
5. Pectic acid.
6. A trace of albuminous matter.

The author described the method employed by him for separating these substances from one another and obtaining them in a state of purity; and he then gave an account of their properties and composition.

The waxy matter is by far the most interesting of these substances. It is insoluble in water, but soluble in alcohol and ether. If a concentrated solution in boiling alcohol be allowed to cool, the greatest part is deposited, causing the liquid to assume the appearance of a thick white jelly, consisting of microscopic needles or scales. When this jelly is filtered off and dried it shrinks very much, and is converted into a coherent cake, which has a waxy lustre and is translucent, friable, and lighter than water. Its melting point is between 83° and 84° C. At a higher temperature it is volatilised. When heated on platinum it burns with a very bright flame. The author thinks it probable that this substance covers the cotton fibres with a thin waxy film, and thus imparts to them their well-known property of resisting water. In its properties and composition it approaches very nearly the better known vegetable waxes, such as that obtained by Avequin from the leaves of the sugar cane, and that which is found on the leaves of the Carnauba palm. The author thinks that the name *cotton wax* is sufficient to distinguish it from these and other nearly allied bodies.

The fatty acid has the properties and composition of margaric acid. It is white and crystalline, fuses at 53° C., and gives with alkalies compounds soluble in water which are true soaps. It is, however, probably not a natural constituent of cotton fibre, but rather an impurity derived from the oil of the seed which escapes and diffuses itself among the cotton before or during the process of ginning. It might also have had its source in the oil and fat, used for greasing the cotton spinning machinery, since the author employed yarn in all his experiments. Persons practically conversant with cotton spinning affirm, however, that if ordinary care be taken, it is impossible that the cotton can become contaminated with anything of a fatty nature, during its conversion into yarn.

The colouring matters obtained in these experiments are without doubt the substances to which raw cotton owes its yellowish or brownish colour. The author was able to distinguish two bodies of a dark brown colour, which occurred in all kinds of cotton examined by him. Of these one is easily soluble in cold alcohol, and is left, on evaporation of the solution, as a dark brown, shining, brittle, amorphous resin, which is transparent in thin layers. In boiling water it softens and melts to a pasty mass, which becomes hard and brittle again on cooling. When heated on platinum foil it burns with a bright flame, leaving a very voluminous coal. It is nearly insoluble in ether. It dissolves easily in concentrated sulphuric acid and glacial acetic acid, with a brown colour. It also dissolves with ease in caustic and carbonated alkalies, giving dark, yellowish-brown solutions, from which it is re-precipitated by acids in light brown flocks. The other colouring matter resembles this in most of its properties. It is, however, much less soluble in alcohol. Cold alcohol, indeed, dissolves only a trace, but in boiling alcohol it dissolves with tolerable facility, being re-deposited, on the solution cooling, in the form of a brown powder. This powder, when filtered off and dried, forms coherent masses of a colour varying from light to dark brown, which are easily broken, showing a dull earthy fracture. Both colouring matters contain nitrogen, and they differ therefore in constitution from true resins, which they resemble in many of their properties. The peculiar colour of the so-called "Nankin cotton" is probably due to a great excess of these colouring matters existing in the fibre. It is certainly not caused by oxide of iron.

The purification of the pectic acid contained in the brown precipitate produced by sulphuric acid was not effected without difficulty. The best method, according to the author, consists in submitting it to a simple process of bleaching with chloride of lime, by which means the impurity, consisting of brown colouring matter, which adheres to it with great pertinacity, is destroyed. When pure it has the properties and composition ascribed to pectic acid by Fremy. The cotton itself probably contains pectose or pectine, which is converted into pectic acid by the action of the alkaline lye. About three-fifths of the brown precipitate consists of pectic acid. Of the remaining two-fifths the colouring matters constitute by far the largest part, the wax and fatty acid being present in very minute quantities. The albuminous matter was not isolated, but its presence was indicated by the formation of a small quantity of leucine, which took place when the brown precipitate was submitted to the action of hydrate of soda. A large quantity of oxalic acid was formed at the same time, no doubt from the pectic acid.

In conclusion, the author makes some remarks in regard to the part which these bodies may be supposed to play during the process of manufacturing gun-cotton. It has been asserted that the instability occasionally observed in gun-cotton is to be attributed to the impurities in the raw fibre, forming, by the action of nitrosulphuric acid, bodies which decompose spontaneously at the ordinary or a slightly elevated temperature. The author's experiments do not support this view, since the substances described by him, when submitted to the action of the mixed nitric and sulphuric acid of the strength employed for making gun-cotton, do not yield explosive compounds.

FOREIGN SCIENCE.

PARIS, MARCH 3, 1868.

Estimation of titanic and niobic acids.—Process for bleaching palm oil by chromic acid.—Solubility of ether in solutions of sugar.—Alcoholate of baryta. ACADEMY OF SCIENCES. Feb. 10: On the heat set in motion during chemical combinations.—A new body analogous to diastase.—Nitrous fermentations.—Influence of light on vegetation.—Electro-capillary actions.—On the part played by electricity in muscular contraction.

THE processes proposed up to the present time for the estimation of titanic and niobic acids in mixtures have not succeeded very perfectly. M. Marignac, after testing the capabilities of the processes already known, has adopted the following. He takes 5 grammes of the metallic acid, and fuses it with 1·5 gramme of hydrofluorate of fluoride of potassium, first heating this salt gently until it is in a state of fusion (this fusion might almost be called aqueous), and then adding the niobic and titanic acids. By allowing the salt to fuse first, loss by decrepitation is avoided; afterwards a powerful heat is applied, and in a minute there is complete fusion, and the metallic acid is completely dissolved. It is not well to prolong the operation, as the mass has a tendency to creep up the sides of the crucible; for this reason a deep crucible should be chosen. The cooled mass is dissolved out by digesting with warm dilute hydrochloric acid, employing for this purpose 20 c.c. of pure concentrated hydrochloric acid and 230 c.c. of water, and the solution collected in a flask. When it is quite cold, a bar of distilled zinc is introduced, sufficiently long to reach the bottom of the flask, and then to protrude at the neck. The flask is closed by a cork carrying a bent glass tube, by which the hydrogen is disengaged under water; the temperature of the solution must never be allowed to rise sensibly. At the end of twenty-four hours, the reduction is terminated, and it is only necessary to remove the cork, and withdraw the bar of zinc, and then to proceed immediately to determine the sesquioxide of titanium by a titrated solution of permanganate of potash. In default of rods of zinc, fragments of the metal may be employed, but they must not be too small; the zinc in this case need not be removed before making the titration. M. Marignac has obtained in the majority of cases very accurate results with the process. In some cases, however, a partial reduction of niobic acid took place, and in others incomplete reduction of titanic acid. The error in the first case can never be great without a brown colouration being manifested. M. Marignac has not been able to convert this quantitative method into one by which the titanic acid can be *separated* properly from the niobic acid. This chemist has also experimented upon the composition of the two other oxides of niobium. The brown oxide appears to be formed by niobic acid losing one-third of its oxygen, being thus intermediate in composition between niobic acid and the blue oxide (which passes so readily into the brown oxide, that no determinations could be made), and possessing the rather complicated formula Nb_3O_5.

The following is a detailed account of the process used by M. Engelhardt, of Leipzig, for bleaching palm oil by means of chromic acid:—A convenient quantity of palm oil is placed in a cauldron and heated to about 62° C., and allowed to repose during a whole night; the next day it is poured into a perfectly clean vessel and cooled down to 40° or 37° C. While this operation is being performed, a certain quantity of water is heated to ebullition; for 1000 parts by weight of palm oil, 45 of water, in this quantity 15 parts of bichromate of potash are dissolved. As soon as the solution has cooled a little, 60 parts of hydrochloric acid are added, and it is then mixed with the palm oil, which is vigorously agitated during the mixing. Five minutes suffice for the oil to be coloured a dull green. By continuing the stirring, the oxide of chromium becomes completely separated; the oil becomes clearer and clearer, and finally quite limpid; when this point is arrived at it is washed with hot water: the product is perfectly white. If the palm oil has not been thoroughly bleached by the treatment, the process is repeated with 23 parts of bichromate of potash, and 1 of hydrochloric acid. This method is capable of rapid execution, and gives very good results.

MM. J. Regnauld and Adrian have examined the solubility of ether in solutions of sugar. They have made experiments in order to solve the following questions:—What is the solubility of pure ether, and of ether more or less alcoholised, in aqueous solutions of sugar of 1·321 density? What augmentation in the solubility takes place when the density of the aqueous solution is changed to 1·261? These and several other questions have been closely examined to obtain data which will be used in revising the Codex.

M. Berthelot has examined the alcoholate of baryta. He has observed in making this compound by reacting, with carbonic oxide in the cold, upon an alcoholic solution of baryta, that the elements of water are separated from the alcohol by the baryta, at the moment of combination. The alcoholate can be obtained by boiling an alcoholic solution of baryta; it separates as an insoluble powder. The supernatant fluid is decanted, and the precipitate dried rapidly at 100° in a current of absolutely dry hydrogen. In the compound thus obtained, M. Berthelot has determined the baryta and alcohol regenerated by the action of water. The numbers obtained by him made a sum nearly 1 per cent in excess of that required by theory, a result which he explains by the elimination of the elements of water already referred to. Alcoholate of baryta, left in contact with a small portion only of its mother liquor, re-dissolves during cooling, yielding a solution much more concentrated than the original one.

At the meeting of the Academy held on the 10th of February, M. Favre contributed a memoir on researches on the heat set in motion during chemical combinations and decompositions.

Three memoirs were sent by M. Dubrunfaut; the first related to a new body analogous to diastase; nitrous fermentations, lately the subject of examination by M. Reiset, formed the subject of the second, and the influence of light upon vegetation the third.

M. Becquerel communicated a further account of his researches in capillary chemistry, and M. Marey brought before the Academy his researches on the part played by electricity in muscular contraction.

M. Favre has studied the compounds formed by the union of sulphuric acid, considered as a hydrogen salt, with zinc, iron, copper, and cadmium. He measured first the heat produced by the oxidation of the metal, then that produced by the combination of the acid with the oxide, and finally that caused by the hydration of the salt. He found that the heat produced by the simultaneous combination of the different elements represented exactly the sum of these quantities. M. Favre adduced new facts in confirmation of a result already announced by him,—that the heat produced by the combustion of a body, or absorbed during reduction, does not represent the whole of the heat put in motion. A certain amount of heat is necessary to prepare the body for combination or decomposition. The general result of M. Favre's work is that in the case of the salts with which he has experimented, these are more correctly represented as direct combinations of SO_4 with the metal, than as sulphates of oxides.

The matter analogous to diastase, described by M. Dubrunfaut in his first memoir, possesses the same property as diastase, but it is distinguished from it in having less saccharifying power, and by the property of rendering fluid 1,000 or 2,000 times more starch. The second memoir was chiefly a criticism of M. Reiset's recent communication on nitrous fermentations. M. Dubrunfaut has obtained in recent experiments confirmation of the theory formerly proposed by him to explain these phenomena. The following is the theory referred to:—Lactic acid is developed, and this decomposes the nitrate of potash of the saccharine juice, liberating a certain quantity of free nitric acid, which, by contact with organic matters is reduced to the state of binoxide of nitrogen; then the binoxide of nitrogen, by contact with the atmosphere, becomes nitrous acid. In M. Dubrunfaut's last memoir, a study of the influence of light on vegetation, he indicates a method of valuing the mechanical work performed by the light in the decomposition of carbonic acid.

CORRESPONDENCE.

THE ROYAL SCHOOL OF MINES.

To the Editor of the Chemical News.

Sir,—Will you kindly allow me to make a few remarks on some of the statements, made by A. L. E. on the School of Mines, which appeared in the Chemical News of last week?

A. L. E. says the School of Mines is an appendage to the Geological Museum; this is quite a mistake,—if the School had 200 to 300 students, the Museum would seem just as much an appendage to the School, as the School now seems to be to the Museum.

"The prospectus or calendar, if it be worthy of the name" writes A. L. E.; now, no one dreams of calling the prospectus a calendar, or wishes to do so (always excepting A. L. E.): as to its being printed "on the spare page of a pamphlet belonging to the Geological Museum," this is not correct. If A. L. E. will look at the prospectus of the present session, he will find that it consists of 42 pages: the first page is the title-page; the next contains a table of contents; pp. 3, 4, and 5 contain a short account of the origin of the School of Mines; pp. 6, 7, and 8 give an account of the Geological Survey Mining Record Office and Library; the rest of the prospectus, pp. 9 to 42 (incl.), *i.e.*, 34 pages, are devoted to the School of Mines; *ergo*, the prospectus is printed on 34 pages, being spare pages of a pamphlet, consisting of three pages, belonging to the Geological Museum.

It would be better, no doubt, if the chemical laboratory was under the same roof as the Geological Museum; but this has very little influence on the number of students, its present position really producing but little practical inconvenience. The real reason of the small number of students is, in my opinion, that it is so little known to the general public. I am sure the names of the lecturers are far more widely known, than the Royal School of Mines with which they are connected. If, as A. L. E. suggests, the session was opened publicly, and the reports of the examiners, at the end of the session, were read out publicly to the council, an account of the proceedings would appear in the papers, and thus the public would be informed of the existence of an English School of Mines far more effectually than in any other way.

If the council would adopt this plan for two or three years, long enough to give it a fair trial (and there is a theatre luxuriant in cushions ready built for the purpose), I can not but think the number of students would be considerably increased.—I am, &c.,

A STUDENT AT THE ROYAL SCHOOL OF MINES.

Jermyn Street, March 3rd, 1868.

To the Editor of the Chemical News.

SIR,—I notice with pleasure a letter in your last week's number calling attention to the present condition of the Royal School of Mines. It is indeed to be regretted, that this, which should rank foremost amongst our scientific training institutions, and which has abundantly proved its utility, should be compelled to exist under so many disadvantageous circumstances. In a silent and unobtrusive manner it has already done much; but there can be no doubt, that by a more judicious arrangement of details, and by the infusion of more energy and spirit into its management and maintenance, its sphere of usefulness might be considerably enlarged. Undoubtedly, bringing the School before the notice of the public, will have the effect of inducing a greater nnmber of students to avail themselves of the excellent opportunities it affords for obtaining scientific instruction: but this is not all; publicity will render more important service by contributing to give the Associates, who must necessarily share the obscurity of the School, a better status in scientific circles than, by virtue of their title, they have hitherto possessed. The course of study which must be pursued in order to obtain the distinction of "Associate," is sufficiently arduous to make the title, were the School better known, one of considerable merit. Candidates are obliged to have a knowledge, not superficial, but somewhat extensive and practical, of chemistry, physics, geology, and mineralogy. These studies occupy the first two years, after which the student may confine himself to that division in which he desires to take his Associateship; thus, if he wishes to pass in the mining division, the third year's subjects are mining, assaying, and applied mechanics; if in the metallurgical division, metallurgy, (theoretical and practical), and applied mechanics; if in the geological division, natural history and palæontology. It appears that about one-third of the Associates have taken up all three divisions; and I should mention that it is necessary to pass in the first class in the third year's subjects. After having completed this course, which it must be acknowledged represents a fair acquaintance with the principal branches of science, the students are sent out into the world with a title which is both little known and recognised, for it is not very flattering to be superciliously asked, "Where is the Royal School of Mines?" "What is the meaning of an Associate?" and whether it is an honorary title. In Dublin what used to be the Mining School is now called the Dublin College of Science, and perhaps if the School of Mines were called the London College of Science, it would be more appropriate, as comparatively few of the students ever have any thing to do with mines. But, apart from that, it is really desirable that the title should at least rank equal to the Associateship of King's College, and that the Associates should be allowed to make use of the initials A.R.S.M., or L.C.Sc. (Licentiate, College of Science), as indicative that the title is by no means an honorary one.

The state of things which renders some such public explanation as this necessary, is probably attributable to the manner in which the School has allowed itself to be tacitly ignored; it has no outward sign of existence, because there is no building which bears its name; it has never, in fact, assumed that position amongst educational institutions which, as a State school, it is entitled and privileged to occupy.

It is reported that the School does not pay its own expenses; if this be so, the authorities must have been strangely blinded to their own interests to have omitted such simple remedial measures as those suggested by your correspondent, for I feel convinced that were its existence and benefits more universally known, and if the title it confers carried with it any adequate amount of social standing, there would be an increase in the number of students, and consequently the School would no longer prove unprofitable, either in a pecuniary sense to the Government, or, in an intellectual sense, to the people. Apologising for intruding so much upon your space. —I am, &c. DELTA.

March 3rd, 1868.

MISCELLANEOUS.

The Chemical Society.—We understand that Professor Kolbe, of Leipzig, is expected shortly in London, and that he will make a personal communication to the Chemical Society, on the direct transformation of carbonate of ammonia into urea. He will also be present at the President's soirée on the 11th instant.

Lectures at the School of Gunnery.—Mr. E. O. Brown is now delivering a course of lectures "On Gunpowder and its Substitutes," including gun-cotton and nitro-glycerine. The modes of firing by electricity and special fuzes will also be described. A similar course of six lectures "On the Chemical History and Military Applications of the Metals," was delivered before Christmas, at Shoeburyness, by Mr. J. Spiller.

Separation of Niobic and Titanic Acid.—C. Marignac. The great difficulties attending the estimation of titanic in presence of niobic acid have been overcome by the invention of the following method: 0·5 grm. of the mixed acids are fused with 1.5 grm. of potassic fluorhydride. The mixture after cooling is dissolved in about 250 c.c. chlorhydric acid of 1·015 sp. gr., and reduced by plunging a rod of zinc into the solution, precautions being taken to prevent access of air. Under these conditions niobic acid remains unchanged, and only titanic acid is reduced to sesquioxide. After 24 hours the zinc is removed, and a standard solution of potassic permanganate added.—(*N. Arch. ph. nat. August*, 1867.)

NOTES AND QUERIES.

Hofmann's Modern Chemistry. Lecture Experiments.—Having repeatedly performed all the experiments described in this book, I may be able to remove some of the difficulties which your correspondent "Amateur" has encountered. First, with regard to the percentage of sodium in the sodium amalgam to be used for the decomposition of hydrochloric acid gas. This is quite immaterial, provided that sufficient sodium is contained in the amalgam to decompose all the hydrochloric acid in the U-tube, and not so much as to render the amalgam solid. The U-tube is not likely to contain more than 100 c.c. of gas, which would weigh 0·16332 grm., and would require about 0·103 grm. of sodium to decompose them, so that if your correspondent dissolves about one gramme of sodium in the quantity of mercury necessary to fill up the U-tube, he will probably have a sufficient excess of sodium to ensure the decomposition of the gas; but as the experiment, as far as I am aware, has never been performed with an amalgam of a known composition, it would be advisable to try it in this manner before positively affirming that the quantities above given would produce the desired result. Next, as to recovering the mercury from the amalgam. If "Amateur" had reflected, he would probably have come to the conclusion that, as he was using sodium amalgam to decompose hydrochloric acid, so hydrochloric acid would be the best reagent for decomposing sodium amalgam; and he will find that if he places the amalgam into dilute hydrochloric acid, the sodium will be removed in a few minutes, and quite as efficiently as by the circuitous process of digesting with a solution of ammonic chloride. "Amateur" complains that the direction to use hydrochloric acid, of the specific gravity 1·1, is indefinite; perhaps 1·10000 will convey a more distinct impression to his mind—for this is what is meant. The object of employing acid of this strength is to avoid the inconvenience of which your correspondent speaks; the liquid not fuming in the air, and not evolving hydrochloric acid when heated.—H. M.

Estimation of Free Sulphuric Acid in Superphosphates.—Permit me to express my astonishment at the Chemistry of "Dr. A. A." as displayed in his replies to "V. C.," on the Estimation of Free Sulphuric Acid in Superphosphates; and to "F. W. W.," on the Determination of Sulphur in Pyrites. "Dr. A. A." informs "V. C." that by first ascertaining the entire amount of sulphuric acid in a hydrochloric acid solution of the superphosphates, and then the quantity of sulphuric acid left, after igniting another portion of the sample, the difference will be free acid. This looks remarkably simple and straightforward on the face of it. But "Dr. A. A." ignores the fact that most superphosphates contain sulphate of ammonia, and no inconsiderable proportion of organic matter. It is not difficult, then, to conceive how these would militate against the accuracy of the results by "Dr. A. A's." process. To say nothing of the entire volatilization of the sulphate of ammonia, or how the sulphate of lime would stand affected by ignition in the presence of carbonaceous matters, a considerable quantity of the free acid would in all probability, under this exciting condition, combine with the lime of some of the undecomposed phosphates. Should "V. C." require a more ready, though not nearly so accurate a process as the admirable one volunteered by Dr. Moffat, Glasgow, I may say, that an aqueous solution of the manure, treated with a very dilute normal solution of ammonia, gives tolerably fair results. Again, as regards "Dr. A. A's." expeditious mode for determining the sulphur in pyrites,—that is a more extraordinary outrage on chemical science than the former one, on which I have just commented. However he gets even "an approximate estimation" by submitting a sample of pyrites (FeS_2) to "strong incandescence for two or three hours in an open capsule"; producing, of course, an indefinite mixture of sesquioxide and protoxide of iron ($Fe_2O_3 + FeO$), and afterwards reckoning the loss of weight as sulphur, is best known to himself: but to me is an inexplicable enigma. I have already, I apprehend, trespassed too much on your space, and will only therefore refer "F. W. W." to almost any handbook on analysis for a speedy way of arriving at the value of pyrites.—S. A. S.

Sulphur in Pyrites.—In answer to the query of your correspondent F. W. W., I beg to offer the following remarks. The method of analysis of sulphur ores usually adopted for commercial purposes is in substance this: a known weight of the ore reduced to fine powder is oxidised (best in a small flask with a funnel placed in the mouth to avoid loss by spirting, and heated on a sand-bath) either by strong nitric acid or nitro-hydrochloric acid (aqua regia), perfectly free from sulphuric acid; after the oxidation is complete, the liquid is evaporated down as far as possible to expel the majority of the remaining nitric or hydrochloric acid; the residue is boiled with a little water, and almost but not quite neutralised by ammonia; a solution of barium chloride of known strength is then added until no further precipitate is produced, the exact point being found by filtering off a little of the liquid after each addition of barium chloride and adding to it a few more drops of the standard solution, care being always taken, in case of a further precipitate being thus produced, to add this filtrate to the original solution, and mix well before filtering a second time. In case of overstepping the mark, it is convenient to have at hand a solution of sodium sulphate of strength precisely equal to that of the barium chloride; this solution may then be cautiously added with repeated filtration and examination of the filtrate with the sulphate solution, until the point is just reached, when addition of sulphate solution produces no further precipitate: by subtracting the volume of sulphate solution thus used from the total volume of barium solution added, the exact quantity of this latter consumed is known. If 1 gramme of sulphur ore be taken, and 32·5 grammes of pure anhydrous barium chloride be dissolved to a litre of fluid, each cubic centimetre of barium solution used will represent ½ per cent of sulphur in the ore examined; 22·19 grammes of anhydrous sodium sulphate being dissolved to a litre for the second solution. In case of lead being contained in the ore, an error is introduced from the formation of insoluble lead sulphate; as lead, however, rarely occurs in any perceptible quantity, this error is negligible, the process only giving approximate results. Where greater accuracy is required, it is advisable to precipitate the sulphuric acid formed from the original liquid (filtered from insoluble residue) by barium chloride or nitrate, and to weigh the barium sulphate produced. Instead of oxidising by acids, the powdered ore may be suspended in caustic potash (free from sulphate), and oxidised by passing washed chlorine into the liquid; lead being converted into dioxide, is thus rendered non-injurious; the alkaline liquid obtained is acidified and precipitated by barium chloride as before. Or the finely powdered ore may be mixed with 7 or 8 times its weight of a mixture of equal parts of sodium carbonate and potassium nitrate, and heated cautiously in a capacious crucible; the mass being finally boiled with water, and the sulphate estimated in the filtrate; in practice, however, it is somewhat difficult thus to avoid loss by a deflagration, especially with rich sulphur ores. In the volumetric determination usually pursued, a curious circumstance is occasionally observable when much free acid exists in the solution, viz., that a point may be reached when the filtered liquid is clear, and remains so even on standing for a short time, but yields a cloud, or even a precipitate, on the addition either of barium solution or sulphate solution; this source of error is mostly avoidable by nearly neutralising the free acid with ammonia. Another convenient process consists in fusing the weighed ore with a weighed quantity of anhydrous sodium carbonate, twice as much potassium chlorate as ore, and 12—20 times as much sodium chloride (added to moderate the action); CO_2 is expelled, KCl formed, and all the sulphur converted into Na_2SO_4; by dissolving the residue in water and estimating alkalimetrically the unaltered sodium carbonate by a standard acid solution, the portion converted into sulphate, and hence the sulphur in the ore, is known. Besides the difficulty of preventing loss by deflagration, this method is open to the small errors caused by the reckoning all arsenic present to be sulphur—usually, however, of no moment for commercial purposes; any calcium carbonate in the ore may, if required, be previously dissolved out by dilute hydrochloric acid.—C. R. A. Wright, B.Sc.

TO CORRESPONDENTS.

R. H. R.—"Liebig's Agricultural Chemistry;" "Johnstone's Chemistry of Soils."

P. Holland.—Received with thanks; too late for insertion this week.

Capt. W. A. Ross.—We shall be glad to see the crystals, if you will send specimens.

R. Broadhurst.—Use hydrofluoric acid gas to obscure the glass globes. Those parts which are required bright must be coated with wax.

Errata.—In Dr. Müller's remarks on Mr. Forbes's lecture on Chemical Geology, reported in our last number, the following corrections are requested to be made:—Page 106, line 14 from bottom, for "*without* solidifying," read "*when* solidifying;" page 107, line 1, for "*divided*," read "*decided*;" line 23, for "*their* mineral chaos," read "*this* mineral chaos."

W. Schofield.—The letter has been forwarded.

W. Skey.—Communications have arrived, and shall be inserted. You will observe that the notes named in your letter have already appeared.

G.—Why will not chalk answer? It will satisfy your conditions.

A. G. S.—The *Bulletin de la Société Chimique de Paris* is published monthly. It can be procured by order through any foreign bookseller.

Solutus.—The normal sulphate of cerium is much more soluble in cold than in hot water, and is precipitated when a cold saturated solution is boiled.

Communications have been received from Dr. Wood; Miss Chapman; J. B. Giles; J. Davies; R. Eaton (with enclosure); J. T. Brown, F.C.S.; Bollman Condy & Co.; W. Field; Dr. W. Bird Herapath, F.R.S.; C. F. Burnard, F.C.S.; F. C. Calvert & Co.; Jones & Co.; P. Dorn; Capt. W. A. Ross, R.A.; H. B. Ingram; Rev. Richard Kirwan; J. Muspratt & Sons; A. Payne; B. Wheeler & Co.; W. Kellner; T. L. Patterson; Dr. E. W. Davy (with enclosure); Dunn & Co.; C. M. King; C. Mitchell & Co.; Baron von Seckendorff (with enclosure); Dr. Forbes Watson; John Knight & Co.; Kingsbury & Co.; Fletcher & Co.; John Davies, M.D.; F. Brooke & Co. (with enclosure); L. Demuth (with enclosure; J. R. Irvine; Reginald Petre; R. Broadhurst; C. Steer; Philip Holland (with enclosure); F. J. M. Page; Dr. H. Muller, F.R.S.; W. Schofield (with enclosure); H. Merivale; F. Scott; W. Skey, New Zealand (with enclosure); W. Cortis, jun.; T. A. Readwin; J. Spiller; D. Forbes, F.R.S. (with enclosure); Dr. Odling, F.R.S.; Professor Heaton; H. Bailliere; Dr. F. B. Courtenay; G. H. Mann, Troy, United States; F. Sutton; W. Bywater; Dr. Adriani (with enclosure).

Books received.—"The Illustrated Photographer;" "Dictionary of Chemistry," by Henry Watts, B.A., F.R.S., F.C.S. Part XLIV. Types, Water. London: Longmans, Green, & Co.; "Hardwicke's Science Gossip;" "Pharmaceutical Journal;" "American Journal of Pharmacy," November, January; "The Scientific Review;" "La Meraviglie Della Scienza;" "Zeitschrift für Chemie;" "Faraday as a Discoverer," by John Tyndall. London: Longmans & Co.

THE CHEMICAL NEWS.

Vol. XVII. No. 432.

ESTIMATION OF NITRITES IN WATERS.

By PHILIP HOLLAND.

Dr. Miller, in his paper "On some Points in the Analysis of Potable Waters,"* alludes to a reaction for the detection of nitrites, viz., the property these salts have of liberating iodine from an acidified solution of iodide of potassium.

Dr. Angus Smith† asserts that an amount of nitrous acid, so small as 1 in 3½ millions of water, may easily be discovered in this manner. In spite of its extreme delicacy, I am not aware that any process for the quantitative estimation of nitrous acid has been founded on the reaction. Most, if not all water analysts, unless they be recent converts, are inclined to be satisfied with permanganate indications, the presence or absence of nitrous acid being assumed according as the permanganate is quickly or slowly decolourised.

The process I am about to describe is one in which the colouration imparted by the free iodine is taken as the measure of the nitrous acid present. For a "colorimetric" standard, I know of nothing better than a solution of iodine in iodide of potassium; about 4 grms. is dissolved in excess of iodide, and made up to the volume of a litre.

In the next place, it is necessary to prepare a pure salt of nitrous acid; for this purpose, commercial nitrite of potassium is precipitated with $AgNO_3$, the resultant silver salt washed by decantation, re-crystallised, and dried in vacuo.

To ·3276 grm. of the silver salt, dissolved by heat in water, is added a slight excess of pure NaCl, and the liquid, when cold, made up to the volume of 1000 c.c.

$$10 \text{ c.c.} = 1 \text{ mlgrm. } HNO_2.$$

The iodine solution is "titrated" as follows:—A permanganate burette divided in $\frac{1}{10}$ths of a c.c., and fitted with a float, is filled with it. Two narrow white glass jars are placed on a white slab; on each is marked the point at which a volume of 200 c.c. of water stands. Into one, A, is put an amount of the standard nitrite equal to 1 mlgrm. of HNO_2, together with 6 c.c. of iodide of potassium (1 to 10 of water), then distilled water nearly to the mark, and lastly dilute H_2SO_4. The whole is to be mixed and allowed to stand until the colour is fully developed; when that point is reached, the second jar, containing an amount of iodide of potassium and acid equal to that in A, is filled to within a short distance of the volume mark with water, and placed under the burette; the iodine solution is then cautiously delivered into it, until the depth of colour is judged to be equal in intensity to that in A. The iodine solution should be of such a strength that 10 c.c. have a colouring power equal to that possessed by 1 mlgrm. of HNO_2 in the presence of iodide of potassium in a volume of 200 c.c. of water. It is unadvisable, when making the comparison, to add the standard nitrite from a burette to an acidified solution of iodide of potassium, for an obvious reason. It may, however, be suggested that a definite quantity of nitrite should be added together with iodide to the water in the jar, and lastly the acid. Such a method is tedious, in that it would be necessary to make several assays before attaining the desired shade.

The following determinations of nitrous acid were made:—An amount equal to 1 mlgrm. was evaporated with a litre of spring water to the volume of 100 c.c., the residue was filtered into the cylinder, and the filter washed; when cold some iodide of potassium was added, then distilled water to within ½ inch of the mark, and lastly dilute H_2SO_4. After thoroughly mixing, the contents of the cylinder were left undisturbed, for the colour to become fully developed; when that stage arrived it was found that 11·5 was the number of c.c. of iodine requisite to impart the same colour to an equal volume of water. 10 c.c. should only have been required; the excess, therefore, of 1·5 c.c. is the measure of the HNO_2 in the water employed. In order to justify this assumption I evaporated two separate quantities of a litre.

	Iodine, c.c.
No. 1.	1·2
,, 2.	1·4

These figures give ·12 mlgrm. per litre as the amount of HNO_2 in the spring water. Artificial waters were made by adding known amounts of HNO_2 to common water; the quantity of HNO_2 already existent therein being deducted.

Amount HNO_2 added in mlgrms.	Iodine required in c.c.	Mlgrms. HNO_2 found.
·43	4·5	·45
·86	8·4	·84
1·52	14·8	1·48

The following natural waters were examined:—

A. A well water.

B. A well water, in which nitrates were found in some quantity.

C. A brook water containing some sewage matter.

A.	·23 mlgrm. HNO_2 per litre.	
B.	·27	,,
C.	·63	,,

The process is not suitable when the quantity of nitrous acid is large; whilst it ranges below and up to 1 mlgrm. corresponding results can be obtained.

Some precautions are necessary in certain cases. H_2S and sulphides if present must be removed; the former escapes during the evaporation of the water; the latter may be decomposed by a metallic oxide.

Organic colouring matter can be precipitated by means of chloride of calcium, carbonate of sodium, and a few drops of hydrate of potassium, as suggested by Dr. Frankland. Kaolin could perhaps be employed for the purpose.

Chorley, March 4, 1868.

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* Journal Chem. Society, May, 1865.

† "Estimation of Organic Matter in Waters, with reference especially to sanitary purposes," page 20.

ON THE DETERMINATION OF TARTARIC ACID.

By GEORGE H. MANN,
Polytechnic Institute, Troy, New York, United States.

Ten grammes of the crude tartar are mixed with a sufficient quantity of pure hydrate of potassa, free from carbonate, in order to neutralise the free tartaric acid present; the mixture is evaporated to dryness in a water bath, and heated to redness in a closed porcelain crucible. The tartaric acid is thus decomposed into carbonic acid, which is determined in the following manner: place the warm mixture of the carbonates and carbon in any of the various forms of the apparatus designed for this purpose, and illustrated in Fresenius' "Quantitative Analysis," fill the upper bulb with strong sulphuric acid, tare the apparatus on the balance, admit the acid into the lower part, when carbonic acid will be evolved, and the amount present may be estimated from the loss of weight. Then we shall have the proportion $CO_2 : C_8H_4O_{10},2HO$ :: the amount of carbonic acid found : the amount of crystallisable tartaric acid present in 10 grammes of crude tartar. Or expressed in numbers, 22 : 150 :: *a* grammes of carbonic acid : χ grammes of crystallisable tartaric acid.

ON THE USE OF THE

SPECTROSCOPE AND MICROSPECTROSCOPE

IN THE DISCOVERY OF

BLOOD STAINS AND DISSOLVED BLOOD,

AND IN PATHOLOGICAL INQUIRIES.

By W. BIRD HERAPATH, M.D., F.R.S.

(Concluded from page 115.)

In red hæmatine an interval exists between the sodium or solar line D and the margin of the first band of absorption, which in red hæmatine is less distinct or *sharp* than that in scarlet cruorine, or than its fellow in the same spectrum; both of which therefore are in red hæmatine found in the green rays. Most chemical reagents convert scarlet cruorine into brown hæmatine without any previous passage through the stage and properties of purple cruorine. The effects of reduction on brown hæmatine are evanescent, and the solution rapidly becomes deficient in optical power; it does not assume the former properties of brown hæmatine. The absorption bands fade away and disappear, the one nearer to the sodium line D being the more persistent, and remaining sharp during several days; this takes place even if the bottle be air-tight. Re-treatment with protoxide of iron will again reproduce the two absorption bands as before. It is brown hæmatine which is usually discovered in old blood stains. but red hæmatine in dry and more recent blood clots. A specimen on the table six months old still shows the two bands of red hæmatine, whilst one of two years old shows the spectrum of brown hæmatine.

It may be as well to state, that these specimens of dried blood had been kept in a moderately dry room, powdered, and in a paper pill-box for some portion of the time, but during the major part of the period on cloths exposed to the air without any care, and in the ordinary atmosphere of an inhabited room, with gas burning nightly. Solutions of these specimens of blood in distilled water, after having been kept closely corked for some days, underwent a peculiar change. Both the brown and red hæmatine were *spontaneously changed* into purple cruorine, and now show only the one broad band of absorption due to that colouring matter. This effect is probably due to reduction by sulphuretted hydrogen. In *no specimen* would it be possible to detect *any globules by the microscope*, as the colouring matters have been all dissolved in distilled water, and the globules destroyed. The microscope would therefore fail in detecting blood in all of them, whilst the chemist might probably recognise it in most of the fluids, and so will the spectroscope. When an old blood stain has been so changed by exposure to air that the hæmatine gives but very faint and indistinct absorptive bands, it is possible by deoxidising the solution of hæmatine by means of a little recently precipitated hydrated protoxide of iron to reproduce the bands in nearly the same intensity, though slightly differing in position, than they were in blood stains of a very recent period of their formation, when scarlet cruorine would of course be the colouring material.

This experiment is readily made by adding a few drops of a weak solution of proto-sulphate or proto-chloride of iron, and then a few drops of liquor ammoniæ; the green hydrated protoxide of iron resulting has a great affinity for oxygen, and at once reduces the hæmatine and restores its colour and optical properties.

It is essential that putrefaction should not have actually destroyed the hæmatine. The spectroscope which has been mounted upon this stand is so perfect in its action that it readily exhibits Fraunhofer's lines in solar or lunar light, and it divides the bright yellow sodium line D into two when properly adjusted. It therefore gives great accuracy of observation, and the stronger dark lines of the solar spectrum become so many fixed points for the comparison of the position of the dark absorptive band of various coloured solutions when they are observed by daylight.

One disadvantage attendant upon the employment of this form of spectroscope is the quantity of material necessary to be employed. Several drops of blood must be at the disposal of the operator to get a sufficient coloured solution to fill the little test-tubes used in the optical examination. By modifying the instrument, and introducing a larger tube for containing the liquid to be examined; say a column of six or eight inches in length, it would be possible to discover one drop of scarlet cruorine in a pint of distilled water without much difficulty, a quantity so minute that no perceptible colour could be visible to the unaided eye, and no other method of analysis would be capable of detecting it. Quantities like these are not always to be had, and a recent well-known case in which I had the opportunity of first using the microspectroscope in a medico-legal inquiry would have altogether failed if I had depended alone upon this "fluid spectroscope," as nearly all traces of blood stains had disappeared from the weapon employed by the murderer in consequence of the hatchet having been left exposed in the woods near Mountain Ash for several weeks after the deed was accomplished (case Reg. *v.* Robert Coe, Swansea Spring Assizes, 1866). It was only on the removal of the head of the hatchet that any appearances of blood were to be obtained from the surface of the handle, which had been protected by the iron ring, and on carefully making thin sections of these stained portions of wood, and treating them with distilled water, a few drops only of a brownish coloured fluid were obtained, which coagulated and became discoloured on boiling; also another drop when placed in a very minute tube, about half an inch long, and the $\frac{1}{4}$th of an inch in diameter, the total contents of which tube were one grain and $\frac{1}{3}$rd of distilled water, gave the optical absorptive bands due to old blood.

This little drop of bloody-coloured fluid was placed on the stage of the microscope, and examined with an inch Ross objective, illuminated by an achromatic condenser, and the microspectroscope was inserted into one of the tubes of a binocular microscope as an ocular lens would be employed. This form of instrument is that known as the Sorby-Browning spectroscope, and it admits of great precision, as it has a lateral spectroscope as well as a terminal one. These two spectra appear side by side in the field of view, and being pefectly parallel, admit of examining substances by two sources of light at the same time, or enable us to make comparisons between two different or similar substances at the same time and by the same kind of illumination—the two spectra being both visible with the same eye. This form of instrument is very sensitive to small quantities of blood; and it would be perfectly easy to detect and ocularly examine the blood contained in the stomach of a rascally "flea," and even dilute it with a teaspoonful of water without losing its properties; especially if he had made anything like a decent forage upon some sanguineous individual. But other forms of spectroscope have been adapted to the microscope by different opticians or inventors. One great objection to the other forms consists in the greater complexity of the arrangements and the variety of adaptations to be made, rendering the observations both difficult and troublesome, involving great loss of time, and, of course, greatly multiplying the chance of failure. But to show how small a quantity of blood is really necessary for recognition with this instrument, Mr. Sorby has distinctly obtained the absorptive bands in a single half globule of dried blood; in order to obtain this result the object was illuminated by a powerful achromatic condenser, and one of Smith and Beck's new $\frac{1}{25}$ objectives was employed.

However, without having gone as far as this, my own observations have proved that it is possible to obtain very evident results from less than one-thousandth of a grain of dried blood, the colouring matter of which had been dissolved out by one drop and a half of distilled water. In fact, comparative experiments proved that in the Mountain Ash case the quantity of blood experimented on, and productive of conclusive results, did not exceed one-thousandth part of a grain; and the justness of the sentence was afterwards proved to the satisfaction of all parties by the confession of the prisoner previous to his execution.

However, this optical or micro-spectroscopic result was in this case also confirmed by the microscopic examination and detection of the blood globules, as well as by the chemical testing of the solution of hæmatine, or rather red hæmatine, for it had not passed to the extreme state of change visible in old dried blood.

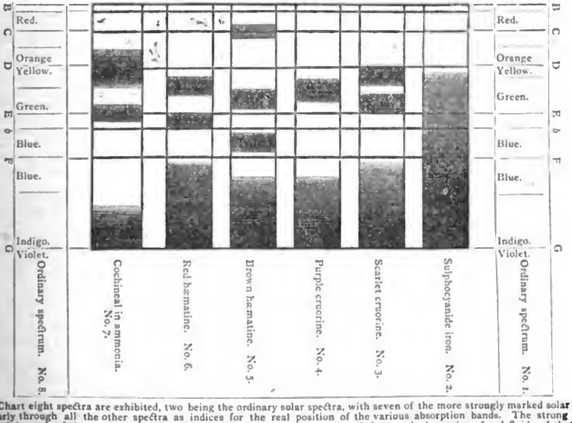
It is somewhat remarkable that though various other bodies have, to the eye, all the appearance and colour of blood, yet none of those usually met with have any spectra to be mistaken for those of the various forms of blood colouring matters herein described. The generality of soluble red colouring matter absorbs more or less of the violet, blue, green, or yellow, and even orange, rays of the spectrum *continuously*. Some wholly absorb the spectrum with the exception of the red ray which they transmit.

The well-known sulphocyanide of iron often called (and used by conjurors and by chemists) artificial blood, is strikingly wanting in those optical absorptive powers or bands so indicative of cruorine or hæmatine in their various forms. Spectrum analysis is capable of rendering great service in chemical and pathological enquiries, as by means of the optical spectra blood may be easily recognised in urine, and detected in some forms of albuminuria, even if it be also charged with the colouring matter of bile. Highly jaundiced urine absorbs all the blue end of the spectrum, but as the green, orange, and red rays are unaltered, the two bands of scarlet cruorine are readily seen. The recent menstrual fluid, when dissolved and properly diluted, gives the spectrum of scarlet cruorine; so does urine mixed with menstrual fluid even if highly bilious. Two substances only have been found comparable in their optical effects to those of hæmatine,—a dilute ammoniacal solution of carmine, and a similar solution of cochineal in ammonia, which colouring matters are very unstable and fade quickly. In both these liquids the same colouring matter exists, as carmine is produced from cochineal. The two absorptive bands are much broader and more diffuse than any of the optical appearances due to the colouring matter of blood, though most like those of brown hæmatine, and only a novice in spectrum analysis could possibly mistake the one for the other, whilst the least attempt at chemical investigation would pronounce them different, the action of heat alone being sufficient to coagulate the colouring matter of blood, whilst the cochineal and carmine would remain unchanged. Reducing agents would also settle the question definitely.

Acids immediately change the colour of cochineal solutions to a reddish orange, deficient in absorptive, and even a spontaneous coloration will take place in the ammoniacal solution of cochineal. Solutions of carmine are more permanent. Acetic acid produces no change at first, but eventually the colouring matter is precipitated. Sulphide ammonium does not alter it in the least, nor does the alkaline solution of protochloride of tin. On adding protochloride of ;iron and ammonia to any solution of carmine, the colouring matter is immediately precipitated in combination with the oxide of iron as a brown or maroon coloured compound.

But one great safeguard in medico-legal enquiries will be the absence of cochineal or carmine from those positions in which blood may by any possibility be found, some cloth fabrics alone being dyed by a mordanted cochineal. Some scarlet clothes also are of this character, and the carmine colour being fixed by alumina, would be insoluble in cold water; whereas the cruorine or hæmatine would dissolve with more or less facility according to its age. It is evident, therefore, that all these considerations render the detection of blood stain by spectrum analysis a matter of but little doubt or difficulty, even when in minute quantities; and, in conclusion, although spectrum analysis does not go one step farther than we were before in our powers of discriminating human blood from that of other mammalian, or red-blooded creatures, yet it gives us greater facilities of demonstrating the presence of the colouring matter of blood, even in inconceivably minute and almost invisible proportions, whilst the facility with which the observations are made is a great, if not the greatest recommendation to the employment of this method whenever practicable.

Chart illustrative of Dr. Herapath's Paper on the Spectroscope.



In this Chart eight spectra are exhibited, two being the ordinary solar spectra, with seven of the more strongly marked solar **lines drawn** perpendicularly through all the other spectra as indices for the real position of the various absorption bands. The strong **black bands** towards the violet ends of the spectrum (which are also absorbed) show the amount of the usual absorption of red fluids of **that end of the** spectrum; but all the other bands are indicative of the fluids examined.

ON THE VENTILATION OF SEWERS.*

By Dr. W. ALLEN MILLER, V.P.R.S.

Determination whether the charcoal injuriously impedes the ventilation.

This could be determined by two methods, viz.—*a.*, by ascertaining the ordinary draught of air in the sewer when there was no charcoal, and then ascertaining the amount of draught after the charcoal had been introduced; or *b.*, by analysing the air before and after the introduction of the charcoal, and ascertaining whether any serious diminution of oxygen or increase of carbonic acid had occurred.

a. The variation of the draught of air in the sewer was examined, as follows:—A puff of smoke was produced by firing a little gunpowder, and ascertaining the time occupied by the smoke in travelling up or down the sewer for a known distance. This method answered its object sufficiently well, but it was found that such slight causes interfered with the strength of the draught, that much less information of value was obtained than had been anticipated, since it was found that the direction of the draught and its amount were liable to be interfered with by local accidents, such as the imperfect closure of a trap, the variable force of the wind, and the opening or shutting of a side entrance: so that the act of entering or leaving the sewer for the purposes of experiment, was more than once found to reverse the direction of the current of air in the body of the sewer during the observations.

So far as the observations go they, however, show that the introduction of the charcoal into the boxes produces a sensible retardation of the current of air. Indeed any other result would be impossible.

Three sets of experiments were made upon this plan; one set before the charcoal was introduced, and two other sets after the boxes had been charged with charcoal.

The average rate deduced from six experiments *without the charcoal* showed a current moving at the rate of 4,254 feet per hour.

The first set of trials, consisting of three experiments, *after the introduction of the charcoal*, gave a current moving at the average rate of 3,263 feet per hour, and the second set of trials, also, an average of three experiments, showed a current of 2,005 feet per hour, in the same part of the sewer.

b. Effect of the charcoal on the chemical composition of the air.

It was ascertained by direct trial that air passed freely through the charcoal in the trays, but no sewer odour was ever perceived in the escaping air; though if the box of charcoal were purposely removed from the ventilating shaft, an immediate and powerful odour of sewage was perceived. The charcoal, therefore, did its work in absorbing the offensive products. It had, however, no direct action upon the atmosphere in the body of the sewer; but, indirectly it might be expected to impair its quality by detaining it for a longer period within the sewer, thereby causing it to lose a larger portion of its oxygen than if a freer current of air was maintained. The oxygen during its detention would combine with part of the decomposing refuse, whilst an increased amount of carbonic acid was to be looked for as one of the products of decomposition; besides which a small quantity of carburetted, and occasionally of sulphuretted, hydrogen might occur in the more stagnant parts.

Samples of air were therefore collected for analysis both before and after the introduction of the charcoal.

From an average of eighteen experiments upon the quantity of carbonic acid, made during the month of May, before the charcoal was introduced, and before the lateral sewers had been provided with flaps, the average quantity amounted to 0·106 parts per cent, while in the open air, the average may be taken at 0·040 parts. The mean temperature of the air within the sewer during this period was 50°·8, ranging between 48° as a minimum and 56° as a maximum.

The mean amount of oxygen in the air of the sewer was for the same interval, from an average of six experiments, 20·71 per cent, the proportion in the open air being 20·96.

After the introduction of the charcoal, the quantity of carbonic acid was found to have risen to 0·132 parts per 100 of air, the mean temperature in the sewer having risen to 56°·2, with a minimum of 52°, and a maximum of 61°·5. The average amount of oxygen was 20·79. No sulphuretted hydrogen was present.

As a general rule it was found that the quantity of carbonic acid in the air within the sewer increased in proportion as the temperature rose in the sewer, and it declined again as the temperature fell.

No connection between the fluctuation in the amount of carbonic acid and the variation of the barometer could be traced.

On the whole, the air of this sewer was not seriously altered by the obstruction occasioned by the charcoal.

But though this sewer in the Avenue Road offered great mechanical facilities for carrying out experiments of this nature, there were circumstances which detracted from the value of the conclusions to be drawn from the results obtained there. The flow of water was rapid (four feet per second), the sewer itself a clean one, and the openings for ventilation numerous; so that, though it was quite certain the use of charcoal in such a case would occasion no difficulty, it did not indicate whether, in a fouler sewer with fewer air outlets, it would still be proper to use the charcoal ventilators.

It was therefore arranged in July that a second sewer should be placed under experiment; and for this purpose the Great Smith Street sewer was judged by Mr. Lovick to be particularly suitable.

The register thermometers were suspended in this sewer in the Brompton Road on the 3rd of October, and samples of the air in its ordinary condition were taken on the 4th and 5th of the month. On the 6th of October charcoal was placed in all the boxes in the ventilating openings, and samples of the air of the sewer collected as before, for analysis.

An average of six samples of air before the charcoal was introduced showed that the air in its normal state contained the large proportion of 0·307 per cent of carbonic acid, with a temperature ranging in the sewer between 57° and 60°, with a mean of 58°·2.

During the months of October and November, twenty-four samples of the air were examined after the introduction of the charcoal, giving a mean of 0·251 per cent of carbonic acid, with a mean temperature of 53°·2, ranging between 49°·5 as a minimum, and 57°·5 as a maximum. The diminution in the proportion of carbonic acid is in no way to be accounted for by the use of charcoal, but is occasioned, no doubt, by the fall in temperature which took place as the days became shorter.

So far, therefore, as these experiments go, even in this tide-locked and imperfectly ventilated sewer, no serious obstruction to the flow of the air through the ventilators was produced by the charcoal. It should be added, that the proportion of oxygen after the introduction of the charcoal was found, on an average of four experiments, to amount to 20°·7 per cent. This sewer was free from sulphuretted hydrogen.

The introduction of charcoal ventilators not only will require a large outlay, but it involves a possible risk to the safety of the men who work in the sewers. The results appear to me to be such as warrant a systematic trial of the method over a limited area.

The second point for inquiry was: *the frequency with which the charcoal will require to be changed* in the ventilating boxes.

As yet the charcoal put into the ventilators in the Avenue Road sewer continues in a perfectly efficient condition. I examined some of the charcoal which had been in the Park Street ventilator (the lowest point in the sewer from the Avenue Road) for nearly six months. It contained nearly one-fourth of its weight of moisture, but appeared as though dry when handled. This moisture had been condensed in the pores of the charcoal, and had not penetrated the box from the road. 100 parts of the damp charcoal gave off, when heated, 19·7 parts of water, and a small quantity of an offensive ammoniacal liquid. Nitrates were also found in small quantity in the products retained by the charcoal.

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* Abstract from the Report to the Metropolitan Board of Works.

The charcoal in the Great Smith Street sewer has been in use only about ten weeks. It is a much fouler sewer, but the results of the examination show that it is still efficient, although in one or two instances, where the traffic is considerable, the mud has worked through the covering, and gained access to the upper layer of charcoal. The lower part of the charcoal was, in each case, clean, and though saturated with condensed moisture, it still effectually purified the air from the sewer, which, as direct trial showed, passed freely through the layer of charcoal.

I examined a portion of the charcoal after ten weeks' exposure in the ventilator in the King's Road. It had absorbed 37·2 per cent of moisture, and the water which was distilled off had the peculiar and offensive odour of the sewage gases.

The charcoal appeared dry to the touch, although it had condensed so large a proportion of water. The important practical conclusion is, that charcoal, though thus saturated with moisture, does not obstruct the escape of air, which it still effectually purifies.

3. *The mechanical arrangements best adapted to the employment of charcoal air filters.*

In the earlier trials, three layers of charcoal, each about two inches thick, were employed. The charcoal was broken into fragments about the size of cob-nuts, ordinary wood charcoal being used. A bushel of this charcoal weighed 15lbs. 2¼oz., and the average weight of the charcoal in the three trays together was 6¼lbs.

Experience showed that some modification was necessary to prevent the road drift from working in; and in the Great Smith Street sewer a single tray of charcoal, 6 inches in depth, was substituted for the three shallower trays with good effect.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 5th.

Dr. Warren de la Rue, F.R.S., &c., President, in the Chair.

The minutes of the two previous meetings were read and confirmed, and a long list of donations to the library announced. Dr. Schenk, Mr. Vosper, and Mr. Gilbert W. Child, were formally admitted as Fellows of the Society, and the following gentlemen were duly elected, viz., Dr. Benjamin H. Paul, 8, Gray's Inn Square; Mr. Thomas W. White, Ifield, near Crawley, Sussex; Edward Dowson, M.D., 117, Park Street, London. Mr. Reinhold Richter, of the Rothamstead Laboratory, was also elected as an Associate. The candidates proposed for admission were John Tyndall, LL.D., F.R.S., Fullerian Professor of Chemistry in the Royal Institution of Great Britain; Frederick Guthrie, Ph.D., F.R.S. Edin., Lecturer on Chemistry in the College of Mauritius; William Brantingham Giles, Chemist at the Borax Works, Old Swan, Liverpool. For the second time were read the names of Mr. R. Calvert Clapham, Walker Alkali Company's Works, Newcastle-upon-Tyne; Rustomjee Byramjee, M.D., Assistant-Surgeon in Her Majesty's Bombay Army; and Edward Menzel, Ph.D., recommended by the Council to become an Associate.

The names of officers and other members of Council proposed for election at the anniversary meeting on the 30th of March were announced. For President, Dr. Warren de la Rue, F.R.S., F.R.A.S, &c. For Vice-Presidents, Dr. E. Frankland, F.R.S., and Dr. J. H. Gilbert, F.R.S. For Foreign Secretary, Prof. F. A. Abel, F.R.S. New Members of Council:—Dr. E. Atkinson, Dr. E. J. Mills, Mr. W. H. Perkin, F.R.S., and Mr. John Williams.

Professor J. A. Wanklyn read a paper "*On the Action of Oxidising Agents on Organic Compounds in Presence of Excess of Alkali*," of which Mr. E. T. Chapman and himself were joint authors. Part I. "*Ammonia evolved by Alkaline Permanganates acting on Organic Nitrogenous Compounds.*" It has already been shown in previous communications that albumen evolves ammonia when submitted to the action of alkaline permanganates, and, further, it is asserted that this ammonia is perfectly constant in quantity, and always proportional to the amount of albumen employed, although the whole of the nitrogen does not take this form. The authors have now extended this enquiry to organic nitrogenous substances in general, and find the action to be definite, yielding proportions of ammonia varying with the nature of the body acted upon, and sometimes the entire quantity was obtained. A number of typical substances were selected for examination, with the following results:—

Class I. Bodies furnishing the *whole* of the nitrogen in the form of ammonia: amylamine, di-amylamine, asparagine, piperine, piperidine (sulphate), narcotine, diphenyltetramide, and hippuric acid.

Class II. Organic bodies which evolve *half* the contained nitrogen in the form of ammonia: morphine, codeine, strychnine, methyl-strychnine (iodide), papaverine, brucine, quinine (sulphate), cinchonine (sulphate), nicotine, naphthylamine, toluidine, and rosaniline (acetate).

Class III. Creatine, which gives off *one-third* of its contained nitrogen in the form of ammonia upon distillation with the alkaline permanganate, is conceived to contain the remaining two-thirds in the form of urea, which by previous experiment was found to give only nitrogen and nitric acid. It is, therefore, concluded that sarcosine, which, together with the elements of urea, make up the original creatine, will furnish the whole of its nitrogen as ammonia,—a supposition which awaits the confirmation of direct trial.

Class IV. Theine, gives off *one-fourth* of the nitrogen.

Class V. includes bodies which evolve various proportions of nitrogen in the form of ammonia. 100 parts of uric acid give about 7 parts of ammonia; caseine 7·6 parts, dry albumen about 10 parts, and gelatine 12·7 parts of ammonia. Picric acid, as the type of a nitro-compound, gives no ammonia on treatment with alkaline permanganate.

The authors finally conclude that nitro-nitrogen does not give ammonia; that amidogen, imidogen, and perhaps nitrogen, are evolved in the form of ammonia from organic bodies derived from marsh gas and its homologues. Compounds derived from hydrocarbons below marsh gas do not give up the whole of the nitrogen as ammonia. The anomalous results obtained in the case of urea are explained by the circumstance, that no oxidation of this substance is possible without destruction of the amidogen. The authors reserve the full consideration of the residual nitrogen (in cases where there is any), and of other complementary products of the oxidation.

A short discussion then took place, having reference to the means of purification of distilled water and the application of the Nessler test, in which Messrs. Dugald Campbell, Wanklyn, Chapman, and Thorp took part.

The President exhibited some interesting examples of phosphorescent salts, arranged in series so as to imitate the colours in the solar spectrum. A butterfly also, with gorgeous wings extended, was constructed by placing the various salts in patches against a glass plate. These illustrations were the work of M. Gaiffe, and were said to have been prepared from the sulphates of barium, calcium, &c., reduced by heating with carbon to the state of sulphides. To start the phosphorescent activity of these salts the frames were exposed to the intense light given out during the combustion of about six inches of magnesium ribbon. [The phenomenon was exhibited with good effect in the meeting-room after the gas-lights had been lowered.]

A "*Note on Dr. Frankland's Process of Water Analysis*" was read by Mr. E. T. Chapman. The author calls in question the accuracy of the method lately proposed for the destruction of nitrates in natural waters, by evaporating with aqueous sulphurous acid, even when perchloride of iron or phosphoric acid is added to the portion of liquid under treatment. The The objections raised were, firstly, that the decomposition was incomplete; and, secondly, that the sulphuric acid formed, or other free acids present in solution, would decompose a portion of the organic matter and entail a loss of carbon.

Mr. Chapman then proceeded to read a "*Note on the Estimation of Nitric Acid in Potable Waters.*" This analytical method depends upon the reduction of the nitric acid to ammonia by the action of nascent hydrogen —a condition practically ensured by distilling the water with pure caustic soda, to expel, in the first instance, any ready-formed ammonia, then cooling the contents of the retort and introducing aluminium foil, which, during solution, effects the reduction of the nitrates to ammonia. After standing for several hours heat is again applied, and the distillation proceeded with until no more ammonia comes over. The amount of the latter is ascertained either by the Nessler test, or by the method of titration with standard acid. The possible occurrence of nitrates in the caustic soda employed is to be guarded against, and some special precautions are taken for the purpose of avoiding loss of ammonia by diffusion of air into the apparatus.

Dr. Williamson inquired whether, in proceeding to effect the destruction of nitrates by sulphurous acid in the presence of proto-salts of iron, Mr. Chapman had exactly adhered to the proportions of these re-agents prescribed by Dr. Frankland?

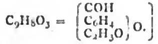
Mr. Chapman said he had used even double the quantity of sulphurous acid without completely decomposing the nitric acid.

Dr. Odling, in rising, said that he was not about to offer any testimony as to the truth or inaccuracy of either of the proposed methods of determining nitric acid; that point would be ascertained, not by discussion, but by patient investigation. It appeared to him possible that both methods of operating would give successful results if all the prescribed conditions were fulfilled. On referring to Dr. Frankland's published paper, which he held in his hand, he found recorded a specific experiment in which a water containing nitrate was treated with sulphurous acid, evaporated to dryness in vacuo, and the residue afterwards burnt. As the result of the combustion, no trace of nitrogen was obtained, and this evidence seemed to be perfectly conclusive. He admitted that apparently trifling modifications in the mode of conducting an experiment might sometimes influence the result, and this showed the necessity of thoroughly working out a process before submitting it to public criticism. For his own part he could not help saying that the new methods lately proposed by Messrs. Wanklyn and Chapman would have met with a more welcome reception at the hands of chemists, if the results, instead of being published piece-meal, had been kept back until a complete and thoroughly verified system of analysis had been worked out.

Professor Wanklyn repudiated the accusation of having brought forward his method of analysis prematurely, by asserting that all the details published in June last had been confirmed by evidence since obtained. He used now, instead of a litre of water, only half a litre for the distillation, and in other trifling respects had improved the process. He would, however, insist upon the truth of the leading axiom, that the amount of ammonia obtained was always proportional to the "badness" of the water, and the method was, therefore, in all cases, applicable.

Professor Abel said that, upon the first appearance of Messrs. Wanklyn and Chapman's method of analysis, he had felt it his duty to inquire into the applicability of the new process; but he soon found that modifications were to be introduced, and that statements made in one paper were contradicted in the next. He had failed in arriving at such definite results as would enable him to adopt the process in its present form, and he entirely agreed with Dr. Odling in considering that the authors had laid themselves open to the accusation of having published their paper somewhat prematurely.

After a few words from Mr. Chapman, the President invited Mr. W. H. Perkin to read his paper "*On the Hydride of Aceto-Salicyl.*" In the present communication, the author gives a fuller account of the hydride of aceto-salicyl, the formation of which was mentioned in a previous paper when treating of the artificial production of coumarine. The body in question was prepared by acting with acetic anhydride upon the hydride of sodium-salicyl in the state of fine powder suspended in pure ether. After twenty-four hours' contact the etherial fluid was evaporated, and furnished a white satin-like crystalline mass upon cooling. It is possessed of aldehydic properties, and has the following composition:—



$$C_9H_8O_3 = \left\{\begin{array}{l} COH \\ \left.\begin{array}{l} C_6H_4 \\ C_2H_3O \end{array}\right\} O. \end{array}\right\}$$

By digesting this product with more of the acetic anhydride, another crystalline body is formed, which fuses at 100°—101° C., and contains the elements of the two substances which give rise to its production. Its formula is then—

$$C_{13}H_{14}O_6 = C_9H_8O_3, C_4H_6O_3.$$

The rest of Mr. Perkin's paper is devoted to an account of the formation of coumarine, from which it appears that this body is only formed when acetate of sodium is present, together with the other ingredients used in its production; this apparent anomaly is explained by assuming the formation, in the first instance, of the sodium-salt corresponding to Gerhardt's "anhydrous biacetate of potassium."

A paper "*On the Absorption of Vapours by Charcoal,*" by John Hunter, M.A., of Queen's College, Belfast, was read by the Secretary. This communication resumes the subject of a previous experimental enquiry, and describes the amount of mixed vapours, as well as of a number of new substances in a state of vapour absorbed by a known volume of cocoa-nut charcoal, under varying circumstances of temperature and pressure. Among the substances examined were the following:—Ethylamine, iodide of ethyl, acetate of methyl, oxalic ether, hydride of salicyl, salicylic acid, iodide of amyl, naphthaline, camphor, nitro-benzol, bisulphide of carbon, alcohol, acetone, and methylic alcohol.

The next paper read was "*On the Occurrence of Prismatic Arsenious Acid,*" by Mr. Frederick Claudet. The dimorphism of arsenious acid was discovered by Wöhler, who found in the flue of a reverberatory furnace crystals of this substance, produced by sublimation, which were not octohedral. The author exhibited a fine sample of a product naturally formed in fissures of an arsenical pyrites ore, occurring in the San Domingos mines, Portugal. This proved on analysis to be pure arsenious

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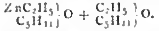
acid in the form of thin plates, similar in appearance and structure to the mineral selenite, and having a beautiful pearly lustre. The specific gravity was found to be 3·85, and hardness 2·5. An analysis of the ore is given, from which it appears that arsenic occurs to the extent of 0·47 per cent, and copper about 3 per cent, with a host of other metals in smaller quantity, including a trace of thallium. There are indications in the mine of a slow process of oxidation having been going on for many years, and the mineral from which the arsenious acid was taken remained quite hot to the touch after it had been raised from the workings. The substance in question is believed to be the result of a very slow process of sublimation, and the form is probably modified by the sulphurous atmosphere pervading those parts of the mine.

Professor Warington Smyth, having been invited to speak, said he was not conversant with the locality where these crystals were found, but from the full description given by the author he thought it probable that his speculations regarding the origin of the substance, were correct. It was interesting as furnishing evidence of the dimorphism of arsenious acid, since two kinds of oxide of antimony were previously known.

The next paper was by Dr. Stenhouse, on the "*Action of Nitric Acid on Picramic Acid.*" The author reconciles the conflicting statements regarding the nature of the products of this action by showing that, according to the degrees of concentration of the acid employed and temperature reached, the products are a mixture in variable proportions of picric acid, and the diazodinitrophenol of Greiss. When much nitrous fume is evolved the latter substance is the principal product.

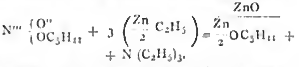
An important communication "*On Chloranil.*—Part I.," by the same author, was then read. In following the best method described for the preparation of chloranil from phenol, that of A. W. Hofmann,—the substance is never produced in the theoretical proportion, but by superadding a treatment with chloride of iodine, the red oil and terchlorquinone become almost completely converted into chloranil, which can then be purified by solution and crystallisation from warm benzol. The action of hydrochloric acid and chlorate of potassium upon picric acid gave but a small proportion,—one-eighth of the theoretical quantity—of chloranil, the chief product being chloropicrin. For the preparation of Städeler's chlorhydranil Dr. Stenhouse directs that the chloranil should be treated with moderately strong hydriodic acid, and about one-tenth by weight of ordinary phosphorus for about half an hour, the product being washed with cold water, and crystallised from boiling alcohol. By the action of sulphurous acid on chloranil suspended in boiling water, the author remarked that other products besides chlorhydranil were formed. Free acids (sulphuric and hydrochloric) remained in solution, which were separated or neutralised with carbonate of lead, and sulphuretted hydrogen passed through the liquid precipitated the heavy metal, and left still in solution an organic compound, which was recovered by evaporation to dryness and sublimation from a paraffin bath heated to 120° C. Lustrous crystals were thus obtained which proved on analysis to be terchlorhydroquinone, $C_6Cl_3H_3O_2$. This treated with nitric acid furnished terchlorquinone $C_6Cl_3HO_2$. A modification of this process will, it is expected, give the bichlor- and chlor-quinone in a state of purity. The author concludes with some observations on terchlorquinone and the bromo-derivative, which, not yet analysed, is believed to be $C_6Cl_3BrO_2$.

Time did not permit of the reading of the next paper, but Mr. Chapman made a short verbal statement of its contents. It is entitled, "*Action of Zinc Ethyl on Nitrous and Nitric Ethers,*" by E. T. Chapman and Miles H. Smith. The authors compared the action of zinc ethyl to that of metals, and show that when operating upon nitrites the residual products are nitrogen, nitric oxide, or the intermediate oxide N_2O. When acting with sodium upon nitrite of amyl a black substance is formed, which has but a transitory existence, and is believed to be the nitride of sodium, NNa_3. Undiluted zinc-ethyl attacks nitrite of amyl with great violence, bursting into flame when placed in contact with it, but if previously diluted with ether its action may be controlled, and gives rise to the production of nitric oxide gas and a honey-like solid mass believed to have the following composition:—



$$\left.\begin{matrix}ZnC_2H_5\\C_5H_{11}\end{matrix}\right\}O + \left.\begin{matrix}C_2H_5\\C_5H_{11}\end{matrix}\right\}O.$$

This decomposed by water gives hydrated oxide of zinc, hydride of ethyl, and amylic alcohol. If the zinc ethyl be used in excess, there is formation of Frankland's dinitro-ethylate of zinc. In proof of this the barium, and subsequently the copper salt, were prepared and analysed. When only a small proportion of ether was employed to moderate the action, the following change occurred:—



$$N''' \left\{\begin{matrix}O''\\OC_3H_{11}\end{matrix}\right. + 3\left(\frac{Zn}{2}C_2H_5\right) = \overline{\overset{ZnO}{\frac{Zn}{2}OC_5H_{11}}} + N(C_2H_5)_3.$$

The triethylamine was recognised by its power of neutralising acids, and of giving by limited oxidation only acetic acid, with consumption of the proper amount of oxygen. The reaction between pure zinc ethyl and nitrite of amyl was characterised as giving a mixture, which, when heated only to 40°C., suddenly exploded with a degree of violence unsurpassed by any fulminating compound of which the authors had previous experience.

The Secretary gave notice that on the next occasion, 19th instant, Mr. Chance will deliver a lecture "*On the Manufacture of Glass;*" and that Professor Kolbe, who will then be in London, will give a short account of "*The Direct Transformation of Carbonate of Ammonia into Urea.*"

A vote of thanks was passed to the authors of the several communications read, and at an unusually late hour the meeting was adjourned.

ROYAL SOCIETY OF EDINBURGH.

Relation of the Chemical Constitution and Physiological Action of Medicine.—Addition of Iodide of Methyl to Vegetable Alkaloids.

At one of the recent meetings of the Royal Society of Edinburgh, a very interesting paper was read by Drs. Crum Brown and T. R. Fraser, upon the influence of direct chemical addition upon the physiological action of substances. This paper is the first of a series which may be expected to throw great light upon one of the most interesting questions which can suggest themselves; viz., the relation existing between the chemical constitution and the physiological action of medicinal and poisonous substances. That such a relation must exist, we can have no doubt; and, indeed, attempts have been made by some to establish the relation in certain cases. Hitherto, however, the subject has not received that systematic investigation which it is now receiving at the hands of the authors of the paper.

In order to arrive at any accurate knowledge as to the influence which chemical constitution exerts upon physiological action, it would appear to be desirable to take substances having a very definite and energetic physiological action, and then to perform upon them a chemical operation, having for its object the promotion of a definite change in the constitution, and to examine the modification which the physiological action has undergone. Such has been the plan which the authors have pursued; the bodies which they have chosen for examination are the more active of the vegetable alkaloids, and the chemical operation, of which they have studied the effect, has been the direct addition of iodide of methyl. It was shown by How that, when iodide of methyl acts upon strychnia, brucia, morphia, and other alkaloids, it adds itself to them, and beautiful crystalline bodies are produced which differ considerably in character from the salts of the alkaloids. The authors have already examined the physiological action of the bodies produced by the addition of iodide of methyl to strychnia, brucia, morphia, thebaia, codeia, and nicotia.

The iodide of methyl-strychnium is prepared by first treating finely pulverised strychnia with a solution of carbonate of potash in dilute alcohol, and then adding an excess of iodide of methyl mixed with about its own volume of rectified spirit, and digesting in a flask for twenty-four hours. The spirit is thereafter distilled off, the residue dissolved in water, and crystallised. It is well known that doses of strychnia, varying from one-twentieth to one-thirtieth of a grain, rapidly produce in rabbits most violent convulsions, and in a few minutes kill the animal; the phenomena produced being due to a localisation of its action on the cord. It was found that twelve grains of iodide of methyl-strychnium, when administered (by subcutaneous injection) to rabbits weighing three pounds, produced no effect whatever. Fifteen grains produced symptoms, and twenty killed; but the animal died with symptoms altogether different from those produced by strychnia. In place of violent and spasmodic convulsions and muscular rigidity, the appearances were those of paralysis with complete general flaccidity. The spinal motor nerves were either paralysed, or speedily became so; and, instead of the speedy occurrence of muscular rigidity, the muscles remained flaccid, contractile, and alkaline for several hours. In short, by the addition of iodide of methyl to strychnia, the toxic properties of the latter are diminished about 140 times; and the body produced possesses the physiological action of curare; viz., paralysis of the end-organs of the motor nerves.

Similarly, Brown and Fraser have discovered that the toxic properties of brucia, thebaia, and codeia are immensely diminished by the addition of methyl; and that the bodies produced, instead of being, as all three of these alkaloids are, strongly convulsent, possess, on the contrary, the physiological action of curare. Morphia, as is well known, possesses both soporific and convulsent properties; its toxic action is much diminished by the addition of iodide of methyl; its convulsent action is destroyed, but its soporific action remains. The above are amongst the chief results which have been obtained by the authors, and appeared to possess such interest as to warrant my drawing the attention of your readers to them.—*British Medical Journal.*

FOREIGN SCIENCE.

PARIS, MARCH 10, 1868.

ACADEMY OF SCIENCES:—Death of M. Foucault.—Products of the distillation of beet-root.—Oxygenated water, not the cause of colouration in ozone test-papers.—Employment of salts of potash in agriculture.—Examination of flour.

On the 17th of February the Academy was informed, by the President, of the loss it had sustained in the death of two distinguished savants, Sir David Brewster and M. Leon Foucault.

M. Pasteur presented a pamphlet, entitled "A Study of Vinegar: its fabrication, accidents, and the means of preventing them. New observations upon the preservation of wines by subjecting them to heat."

MM. Pierre and Puchot presented a memoir, entitled "Experimental researches on the products of the distillation of beet root."

M. Chacornac addressed a note concerning the intimate constitution of light and the formation of nebulæ.

M. Phipson sent a note on some luminous phenomena which accompany meteoric showers.

M. Houzeau sent a note on oxygenated water considered as not being the cause of the alterations induced by the atmosphere in litmus, and iodide of potassium and starch paper as ozone tests.

Experimental researches on the employment of salts of potash in agriculture was the subject of a note by M. Deherain; and there was a note on the qualitative and quantitative examination of rye flour; and of alcoholic liquids by means of chloroform, from M. Rakowitsch. These are all the communications relating to chemistry brought before the Academy at this *séance*; there were several physiological papers, among others one upon the nature of vaccine virus, which elicited considerable discussion.

The memoir of MM. Pierre and Puchot, communicated by M. Wurtz, is an account of a research which has occupied them more than three years. It relates, as has already been mentioned, to the products of the distillation of beet root. When the ordinary rectification of the fermented liquor is observed with attention, a disagreeable penetrating odour is perceived in the first portions which come over. These products often cause liquids with which they are mixed to colour spontaneously. The disagreeable odour of the products manifests itself a considerable time, to the annoyance of the distillers, since they are obliged to keep the portion contaminated separate from the alcohol of good flavour which follows, and sell it at a reduced price. MM. Pierre and Puchot have observed the presence of a vinic aldehyd, of which they have separated, though not without considerable trouble, several litres. The aldehyd thus separated, boils a little below 22°; a specimen made three months ago is still perfectly clear.

If, towards the end of the distillation, a sample be collected and examined, the odour of amylic alcohol will be perceived; at the end of the operation, this alcohol distils over almost free from other alcoholic products. Examined more closely at this stage, the distillate is found to contain other definite substances, such as butylic and propylic alcohols. To test the nature and purity of these two alcohols, MM. Pierre and Puchot have prepared the corresponding iodides and acetates. The butylic alcohol boiled at 107·5°, its iodide at 122·5°, its acetate (isomeric with ethylic butyrate) at about 116°. The propylic alcohol boiled at about 98·5°, its iodide about 104·5°, and its acetate (isomeric with methylic butyrate) about 105°. In conclusion, they remark upon the deceitful nature of the appearances manifested when investigations of bodies such as they have been working upon are made with restricted quantities of material. It is not easy, they say, to distinguish always mixtures possessed of a relative stability from definite and true compounds. Elementary analysis, too, cannot always solve the point, and many examples are cited to show how mixtures of two alcohols may yield the same percentage results as a third pure alcohol.

Some of the other memoirs deserve more than a passing notice, and your correspondent will introduce accounts of them hereafter.

M. Dehérain has arrived at a certain number of conclusions regarding the employment of salts of potash in the cultivation of wheat, potatoes, and beet-root. He finds the salts of potash have generally augmented the wheat crops, which have been augmented still more when ammoniacal salts and phosphatic manure have been also added. Pure potash manures have not increased potato crops; when ammoniacal salts and phosphates have been added as well, a slightly greater yield has been obtained, but not sufficiently to make the employment of these manurial agents profitable. In the cultivation of the beet-root the facts are precisely the same.

The experiments upon which these conclusions are based were made upon a large scale in a part of the domain of l'Ecole de Grignon.

M. Rakowitsch proposes a method of examining flour by means of chloroform. The following are the results which he says may be gathered from an experiment capable of being made in a few minutes:—The amounts of bran, the moisture between 10 and 25 per cent, the damaged flour, the mineral matters, the ergot of rye, and other impurities. The whole of these are determined by the relative specific gravities of the different substances in chloroform. The flour is simply placed in a tube and mixed with chloroform; the chloroform is enabled to hold in very thorough suspension the pure flour, while the other materials are not thus suspended. By adding spirits of wine of 95°, the flour is precipitated to the bottom of the tube. The more humid the flour, the more spirits of wine must be added, and thus the amount of humidity in the flour is arrived at.

NOTICES OF BOOKS.

Boiler Deposits: On the Chemical Nature of the various kinds of Boiler Incrustations, and on some of the methods which have been proposed to remedy them. By Dr. T. L. PHIPSON.

IN the form of a small pamphlet, the author reproduces the text of a paper read at a meeting of the Inventor's Institute in December last. The chemical nature and circumstances of formation of boiler deposits are fairly discussed, several proposed means of prevention described, and a few practical remarks appended which are likely to prove useful to engineers. In the manufacturing districts of Lancashire and of the midland counties many disasters must have been prevented by the system of periodical inspection carried out during the last few years by the so-called Boiler Associations; but much yet remains to be done towards extending their operation in new localities, and particularly in order to guarantee the safe working of boilers attached to portable engines, which are now so commonly placed in the hands of agriculturalists. The greatly extended use of small steam lifts and cranes, and of boilers constructed around the flues of forges and reheating furnaces, appears likewise to increase the risk of danger from explosion—and many sad calamities have been reported during the past year. Apart from the question of personal safety, there is a wide margin for the exercise of economy in the working of a steam boiler, and Dr. Phipson assures us that the loss of heat, or of combustible, in a thickly-incrusted marine boiler, may amount to as much as 40 per cent! In all cases where an adherent mineral scale is permitted to form, the consumption of fuel for all constructions of boilers must necessarily be somewhat augmented, and the operation of chipping tends certainly to loosen the rivets and weaken the plates.

The composition of boiler deposits is considered under three heads, viz.:—Fresh water deposits consisting chiefly of carbonate of lime; salt water deposits invariably composed of a mixture of sulphate of lime and hydrate of magnesia; and abnormal deposits containing incrusting matters derived from mine waters, canals, or streams contaminated with metallic salts and other kinds of refuse from chemical works. Impure waters of this class are known to be especially liable to induce corrosion of the boiler-plates, and a red deposit analysed by Dr. Phipson contained more than 9 per cent of peroxide of iron, due to the rusting of the metallic surfaces of the boiler. Two years ago Dr. Voelcker* gave an account of marine-boiler incrustation, and called attention to the large amount of magnesia contained in it. Dr. Phipson now appends a further analysis which, from its interest, is here subjoined:—

Marine Boiler Incrustation.

Sulphate of Lime	65·00
Magnesia	19·00
Water	13·50
Oxide of Iron and Alumina	0·85
Chloride of Sodium	0·70
Sand	0·45
	99·50

The author proceeds to remark—"This analysis shows that marine incrustation consists chemically of an atom of sulphate of lime united to two atoms of hydrate of magnesia; and that the sulphate of lime is combined here with *one* atom of water, instead of two as in ordinary gypsum." This statement is not, however, in harmony with his own results (quoted above), which demand, on the contrary, the following formula:—

$$2(MgO,HO)+HO,2CaOSO_3.$$

It will be perceived that *dihydrated* sulphate of lime—a compound described by the late Professor Johnston under the name of "boiler sulphate,"—is really deposited, together with the hydrate of magnesia, at the increased temperature of water boiling under considerable pressure.

Dr. Phipson then enumerates several of the ingredients which have been proposed as means of prevention. Of boiler compositions which act only mechanically, the author mentions scrap-iron, clay, starch, and potato-parings. A varnish for coating the interior of boilers, is compound of equal parts of black-lead and suet, with small quantities of charcoal-dust and coal-tar oil. As an objection to this lacquer, it is said to require frequent renewal. Professor Chandelon, of Liège, recommends a mixture of—

Bullock's blood	5 parts.
Starch	2 „
Carbonate of soda	2 „

The use of sal-ammoniac is condemned on account of its rusting the plates. The most efficacious remedies are the carbonate and hydrate of soda, and the author proposes to feed the boiler with water from which the lime and magnesia salts have been previously precipitated by addition of alkali to the contents of the supply tank. Dr. Phipson calculates that 24 grs. of the carbonate of soda, or 14 grs. of the hydrate, should be allowed for every gallon of water, and now that a sufficiently pure quality of the hydrate can be procured for 3d. per lb. (misprinted 3s.) the use of soda is recommended as being both effectual and economical with all kinds of fresh water; but for marine boilers so large a quantity would be required, that the author prefers to combine this alkaline treatment with the system of frequent "blowing off," whereby much of the calcareous refuse can be ejected in a sandy or granular form.

CORRESPONDENCE.

NESSLER'S TEST.

To the Editor of the Chemical News.

SIR,—I have used the following modification of Nessler's process for the estimation of small quantities of ammonia, by which considerable expedition is gained without, as far as I am aware, sacrificing accuracy. It is based on the fact that a solution of iodine, dissolved in iodide of potassium, imparts to water a colouration very similar to that produced by the Nessler test with ammonia. Where the quantity of ammonia was small, say ·4 mlgrm. in 200 c.c. of water, I could perceive no difference in looking *down* the two cylinders standing on a white surface; the real difference, however, becomes quite apparent if viewed laterally. I conduct the process as follows:—A permanganate burette, divided into ·1 of c.c., and fitted with a float, is filled with a solution of iodine dissolved in excess of iodide of potassium; the strength is best determined by experiment.

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* Report of the British Association, 1865; p. 39.

Into one of the cylinders is put an amount equal to ·4 mlgrm. of NH_3, together with 200 c.c. of water, and the Nessler test, taking care to mix thoroughly. As soon as sufficient time has elapsed to allow of the colouration attaining its darkest shade, a second cylinder, containing a volume of water equal to that in the first, and to which has been added a little solution of iodide of potassium (1 to 10 of water) is placed under the burette, from which is delivered the solution of iodine, until a point occurs when, on looking *down* the cylinders, the shades of colour in each are judged to be alike. From this it follows that, provided the "tinctorial" power, and consequently "titre" of the ammonia standard be correctly ascertained in terms of the iodine solution, the former may be dispensed with.

This modification, it will be observed, obviates the numerous assays it is necessary to make when the ammonia standard is retained, besides saving no inconsiderable time in the execution of an analysis.—I am, &c.

Philip Holland.

Chorley.

WATER ANALYSIS AT THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

Sir,—During the discussion at the last meeting of the Chemical Society, Mr. Abel, the chemist to the War Department, took occasion to remark, in reference to our method of water analysis, that our paper describing it contained many things that were incorrect, and on my asking him to be kind enough to name some of those things that were incorrect, I could get no answer from him.

* * * * * * *

I have made an examination of our paper, and find absolutely nothing which I can say is incorrect; the most that I find is a single expression in a parenthesis, which appears to be doubtful. We have used the word "usually" instead of "sometimes" in this parenthesis. The paper is distinguished by extreme accuracy and fidelity to the facts, but is in parts unartistic, and gives an undue degree of prominence to certain results. Owing to this circumstance, notwithstanding its accuracy, it is calculated to lead those persons into error who glance at a paper without reading it.

There is much misconception current respecting our method—far greater misconception than could possibly have arisen from this cause. Indeed, it seems as if the current notions about it have been derived, not from our paper describing it, but second-hand from the writings of our detractors. A *bon mot*, by a Fellow of the Chemical Society when our method was brought out, will serve to characterise much of the causes which have produced these misconceptions:—"The worst fault of your water-analysis," said this gentleman, "is that it proceeds from you."

One of the most curious of these misconceptions is that we direct people to determine the urea in a water by taking a litre of it, adding carbonate of soda and distilling off 300 c.c., and then measuring the ammonia in the 300 c.c. of distillate.

Our directions given last June were, "go on distilling until no more ammonia can be detected in the distillate." So far from, in any way, leading people to believe that the first 300 c.c. will contain all the ammonia proceeding from the urea, we warn people against expecting to find it all there; we talk about the necessity arising for the addition of ammonia-free water, so as to fill up the retort, and finally we give examples where the urea-distillate reaches 600 c.c.

I understand our detractors to say that our process for the estimation of urea does not give the whole of the ammonia derived from it, but only a fraction of it. Such a notion is intelligible enough in conjunction with the belief that our method consists in seeking for urea-ammonia only in the first 300 c.c. of distillate. I understand that some of them are anxious to construe the remark made in my paper on "the verification, &c.," that the estimation of urea is not so sharp as the estimation of albumen, into a round-about way of saying that the decomposition of urea into ammonia is incomplete. Let them be undeceived. There is no failure of the reaction. The want of sharpness in the estimation is due only to a manipulatory difficulty, which might be got over if necessary. It arises from the division of the ammonia into too many portions, and the consequent accumulation of experimental errors.

Those gentlemen to whom the *bon mot* is applicable, are jubilant over the fate of the determination of albumen. Say they, you promised us a complete conversion of the nitrogen of albumen into ammonia, and you give us some kind of an incomplete transformation. We have given them everything we promised, and much more too. If our detractors will not merely glance at our paper, but read it carefully, they will find a warning that the first third of the ammonia derived from albumen is only to be got when the potash treatment is pushed to dryness, and after getting that first third in that manner, the remaining two-thirds are to be had on using the permanganate. It was in that manner that the total ammonia was got from albumen.

In our paper, however, we say in effect, if you have to make a water analysis do not distil to dryness. When we wrote our paper last June, it was for us an undecided point whether or not the neglect to evolve the first third of ammonia by means of potash would involve the ultimate loss of it—whether, in fact, there would be more ammonia on the employment of the permanganate to make up for absence of ammonia during an imperfect potash-treatment.

This question, although interesting on scientific grounds, and the answer to which will go a long way towards the disclosure of the rational constitution of albumen, was in my opinion of comparatively little consequence in reference to water analysis, and we adjourned the consideration of it to a more convenient season. In our opinion it did not matter at all whether the modification we recommended on the score of practicability involved the representation of albumen by a fraction instead of the whole of its ammonia. The essentials for water analysis were that the method should really cope with the infinitesimal quantities of organic matter existing in water, and that its indications should be reasonably parallel with the degree of badness of the water, and that it should be practicable. The possession of these qualities is characteristic of our method, and will, we believe, secure its general acceptance. The absence of these qualities is one of the most prominent features of the method which at the present moment is the rival of our own.—I am, &c.

J. Alfred Wanklyn.

London Institution, March 9, 1868.

ON THE REDUCTION OF CARBONIC ACID TO OXALIC ACID.

To the Editor of the Chemical News.

Sir,—It is due to ourselves, as well as to the chemical public, to throw some light on our relations to a discovery which is claimed by a chemist who worked with us in the same laboratory. It is the synthesis of oxalic acid from carbonic acid and potassium, a fact which is decidedly of great interest, as it shows the direct transformation of carbonic into oxalic acid, and is a new proof of the truth of the views which reign at present on the constitution of the latter body.

Occupied during the course of last summer with similar synthetical experiments, we were, by a very simple reflection, led to the idea of preparing directly oxalic acid from carbonic acid, an idea the execution of which was clearly pointed out by the successful experiments of Mr. Wanklyn on the formation of propionic acid.

The reflection that the group CO,HO, common to all organic acids, and already prepared synthetically in combination with alcohol radicals, could exist independently as a molecule, only doubled, that is to say, as oxalate of potassium, leads, consequently, to the synthesis of the acid.

We began our experiments in the Liepsic Laboratory, in presence of a considerable number of chemists, who took a lively interest in the proceedings of our research. Amongst them we observed Dr. Drechsel.

The first we tried was the action of liquid carbonic acid on potassium. We were not disturbed by the observation made by Dr. Drechsel on this occasion, that an English chemist had tried already the same experiment (executed only in order to state the solubility of potassium in liquid carbonic acid), without mentioning the formation of oxalic acid, for which he evidently was not looking.

The experimental difficulties, namely, the execution of the reaction in a Faraday tube, as well as the close of the laboratory by the holidays, obliged us to interrupt our research, the continuation of which was clearly indicated at the occasion of the lecture experiments on liquid carbonic acid with Natterer's apparatus in the course of the following winter.

It is easily explained that our experiments in that direction escaped the memory of our highly esteemed teacher, Professor Kolbe, who at this time was fully occupied by the new building of his laboratory, and by other official occupations, so that he, half a year afterwards, proposed to Dr. Drechsel the same research which had led us, six months ago, quite independently, without any impulse, to the above-mentioned experiments.

* * * * * *

We are, &c., J. Wischin and Th. Wilm.

Berlin, March 8th, 1868.

THE ROYAL SCHOOL OF MINES.

To the Editor of the Chemical News.

Sir.—"A student at the Royal School of Mines" states in the Chemical News of last week, that I am in error when I look upon the Royal School of Mines as an appendage of the Geological Museum (when I say the Geological Museum, I include the Geological Survey). Notwithstanding what he has said, I still think that I am right in so regarding it. To support me in this opinion I will for a moment refer to the "pamphlet." On page 3, paragraph 1, we are told that the Museum and the School have arisen from the wants of the Geological Survey; this is substantially repeated in paragraph 5; and in the following paragraph we are distinctly told that the School "has grown out of, or engrafted itself upon, the Geological Survey." So that the Geological Survey is the trunk, and the School is one of its branches, and therefore an appendage.

I perhaps made use of too strong an expression when I said that the prospectus was printed on the spare pages of a pamphlet belonging to the Geological Museum; what I meant was that the School does not occupy the position of primary importance in it which it should; the accounts of the Geological Survey, of the Museum, and of the Mining Record Office, all take precedence of it; and this may be seen from a glance at the title-page,—thus, "Geological Survey of the United Kingdom, Museum of Practical Geology, and Royal School of Mines," whereas those departments, being quite distinct from the School, should have a prospectus of their own, while the School should have its calendar printed in a separate form. The pamphlet is neither wholly a prospectus nor a calendar, it is nothing but an economical make-shift, attempting to perform the functions of both; advertisements of maps occupy one cover, whilst the "Arrangement of Lectures," as if of no importance, is ignominiously consigned to the inside of the other. I am rather surprised that a student of the Royal School of Mines should have raised a discussion about such a triviality as this is when compared with the general welfare and position of the School.

I cordially agree with "Delta" in his remarks respecting the Associates, although I must say that the term "Associate" is often used as an honorary one, and is generally regarded as such. I think that the excellent course of study now marked out might be somewhat improved by adding mathematics to the list of subjects; and it would be a great help to the students in the Geological department were the course to include botany; both these subjects are taught in the Dublin School. I may perhaps suggest that the certificate of proficiency would derive an additional value were they to be signed by the director, Sir Roderick Murchison, as well as by the Professor.—I am, &c. A. L. E.

MISCELLANEOUS.

Test for the Presence of a Free Acid.—Dissolve chloride of silver in just sufficient ammonia to make a clear solution. If a little of the test be added to ordinary spring water, the carbonic acid present in the latter will neutralise the ammonia and precipitate the chloride. The above forms a good lecture experiment, the test being a very delicate one.—Edwin Smith; *Nottingham, March 5, 1868.*

The Soiree of the Chemical Society.—On Wednesday evening the President and Mrs. Warren de la Rue gave an entertainment at Willis's rooms, which was one of the most successful ever known in connection with this Society. The rooms were filled with chemical and philosophical apparatus, and the walls were hung with pictures by Landseer, Turner, Gainsborough, &c., some excellent chromo-lithographs by Hanhart, and a fine collection of photographs. General Lefroy, R.A., sent some ancient fire-arms from the Rotunda collection. The War Office contributed an illustrative series of the Ordnance projectiles and rockets now used by the service. A specimen of meteoric iron from Cranbourne, Australia, with the surface etched by acid to show the structure, and a remarkable example of the formation of blisters, due to the evolution of hydrogen beneath the lead coating of Armstrong shot; an illustration of metal-work cut with the band-saw, as used in the Royal Carriage Department, Woolwich; an Abyssinian 7-pounder double shell, whole and in section, with bursting charge of 1 lb. of powder; and an explosive shell, made to resemble a piece of coal, used on board the blockade-runners to effect the destruction of the boiler, when the vessel was about to be captured by the Americans, were kindly lent by Professor Abel, F.R.S., Chemist of the War Department. Dr. Hugo Müller, F.R.S., and Dr. Warren De la Rue, F.R.S., exhibited two hundred cells of their chloride of silver battery; Mr. Ladd exhibited the electric light from it, and its power of decomposing water. Messrs. J. J. Griffin and Sons showed Dr. Russell's apparatus for gas analysis, Tate's air pump, Leslie's freezing apparatus, and their hot-air bath. A large series of metallurgical preparations, consisting of oxides and salts of platinum, gold, silver, palladium, &c., by Messrs. Johnson and Matthey; some magnificent samples of thallium and its salts, by Messrs. Hopkin and Williams; a new electrical pyrometer, by C. W. Siemens; a polarising instrument, by Mr. J. Huggins; a colorimeter, and a number of other instruments, by Mr. W. Ladd, were all much admired. About 800 visitors were present, and the entertainment was continued till a late hour.

NOTES AND QUERIES.

Carbonic Acid.—Can either of your correspondents suggest any crude native, earthy, or metallic carbonate which parts with its carbonic acid, pure and undecomposed, at a moderate red heat?—G.

Prussian Blue Paste.—Would any of your kind correspondents inform me how the bronze is brought out on this article?—J. R. J.

Microscopic Detection of Flour.—Could you oblige by informing me if there is any, and what, method for detecting pea or bean flour when mixed with common wheat flour, except from the appearance of the starch granules under the microscope?—Q.

Estimation of Phosphoric Acid.—Will you oblige a subscriber to your journal, by informing him where he will find the best and simplest means for ascertaining the quantity of phosphate in artificial manure? Would it be too much to ask you to give the best method in your journal? I observe, in your number for February 28th, a valuable contribution from Mr. Burnard, but it is not sufficiently explicit. Our manure dealers tell us that we cannot judge of the quality of their manures by the soluble phosphate alone, as they contain also a considerable quantity of insoluble, or neutral phosphate. I do not care to know what other matters their manures contain, such as ammonia, soda, potash, &c., &c.; I simply want to know their phosphatic value.—Agricola.

Estimation of Phosphoric Acid.—Reading in your last week's paper an article "On the Volumetric Estimation of Phosphoric Acid," by C. F. Burnard, F.C.S., I venture a few remarks upon this subject. The author uses the process of precipitating the phosphoric acid as phosphate of uranium by a solution of nitrate of uranium, and applies it principally to the analysis of phosphatic manures. Several attempts have been made to introduce the above-mentioned process, but they have failed until now, and principally because of the presence of iron in very nearly all manures. To determine the phosphoric acid in manures, a quantity of acetate of soda has to be added, since a precipitate of phosphate of uranium will only appear when the solution has been made acid by acetic acid. The iron present is precipitated as phosphate of iron. Had this precipitate the same composition in every case, the phosphoric acid in it could easily be determined; but this not being so, a more complicated method has to be adopted. I have tried to substitute citric or tartaric acid, to prevent the precipitation of phosphate of iron, but they unfortunately hinder also the precipitation of phosphate of uranium. Perhaps Mr. Burnard has found some more simple way to overcome this difficulty, and if so, I am sure that all chemists would be very glad to hear an account of it. —V. C.

Estimation of Phosphoric Acid.—Having seen some remarks in your last issue on the above subject by Mr. Charles F. F. Burnard, I should feel greatly obliged if he will inform me what is the reaction of the soluble phosphates with caustic soda, also the strength of his standard solution. On reading his article, it occurred to me that it might answer for the determination of $3CaO.PO_5$ in bone-ash and other commercial phosphates. I therefore prepared a normal solution of caustic soda. I then dissolved 10 grammes of bone-ash, which I knew to contain 75 per cent of $3CaO.PO_5$, in HCl, neutralised the free HCl, made up to 400 c.c., and proceeded with the standard solution of NaO, of which 50 c.c. were required to make the solution alkaline. Now 50 c.c. = 50 × ·031 = 1·55 grammes of NaO required for 3·75 grammes $3CaO.PO_5$, or 2 equiv. NaO are equal 1 equiv. of $3CaO.PO_5$, and not 3 equivalents NaO to correspond with the same number of equivalents of CaO in $3CaO.PO_5$.—J. J. K.

TO CORRESPONDENTS.

G. Kellog.—No report has yet been made on the alleged discovery It is not generally credited. Our neighbours do not hurry themselves.

Librum.—Dr. Marcet's is the most suitable of the books you name; then Dr. Hassall's.

H. Fisher.—Our publisher will write to you on the subject.

Amateur.—The method of cleaning and drying U-tubes is too simple to need description in our columns.

Communications have been received from Victor Cruse; J. Landauer (with enclosure); R. Beezley; Rev. Edwin Smith (with enclosure); H. Neale; W. Lea; Ernest Hart (with enclosure); Dr. Odling, F.R.S.; G. Kellogg; G. Wischin and Th. Wilm (with enclosure), W. Little (with enclosure); H. Sugg; C. Collins; A. Liversidge; H. McLeod (with enclosure); Dr. H. E. Roscoe, F.R.S. (with enclosure); H. Fisher; F. O. Ward; J. Samuelson; P. Spence; Messrs. Townsend and Adams, New York; Stephen Dowell; Capt. W. A. Ross (with enclosure); J. Blackburn (with enclosure); J. Apjohn; Foot & Co.; A. Payne; Prof. Wanklyn; Alex. S. Macrae; T. R. Fraser, M.D., Nova Scotia; Dr. Watts; S. Mellor; Niel Mathieson; T. Brown; Dr. W. Bird Herapath, F.R.S.; C. J. Woodward; J. Dobson (with enclosure).

Books Received.—"List of Chemicals and Drysalteries," from Messrs. E. Brooke and Co., Manchester, Glasgow, Bradford, and Huddersfield; "On Vanadium," by Henry E. Roscoe, B.A., F.R.S.; "On Faraday, as a Discoverer," by Professor Tyndall, LL.D., F.R.S.;" "Report of Medical Officer of Health for the Limehouse District;" "The Acadian Reporter;" "The Mining Gazette," Halifax, N.S.; "Le Moniteur Scientifique."

MEETINGS FOR THE WEEK.

Monday.—Medical, 8.
Tuesday.—Royal Institution, 3. "On Historical Portraiture," Mr. G. Scharf.
Wednesday.—Meteorological, 8.
—— Society of Arts, 8.
—— London Institution, 6½.
Thursday.—Royal Institution 3. "On Historical Portraiture," Mr. G. Scharf.
—— Royal, 8½.
—— Zoological, 4.
—— Chemical, 8. "On the Artificial Production of Urea," Prof. Kolbe. "On the Manufacture of Glass," Mr. H. Chance.
—— Royal Society Club, 6.
Friday.—Royal Institution, 8. "On Alloys and their Uses," Prof. Matthieson.
Saturday.—Royal Institution, 3. "On the Non-Metallic Elements," Professor Roscoe.

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3537. A. V. Newton, Chancery Lane, "An improved method of manufacturing cast steel and malleable iron."—A communication from E. L. Seymour, New York, U.S.A.—Petition recorded December 12, 1867.

3605. J. Jowett, Parkhead, Lanark, N.B., "Improvements in furnaces."—December 28, 1867.

3707. M. A. F. Mennons, Southampton Buildings, Chancery Lane, "The manufacture of a vegetable substitute for animal hair from a product not hitherto used for that purpose."—A communication from W. Staufen, Rue Auber, Paris.

3714. H. Bessemer, Cannon Street, London, "Improvements in the treatment of crude or cast iron, and in the manufacture of malleable iron and steel."—December 31, 1867.

28. J. T. Emmerson and J. Murgatroyd, Heaton Norris, Lancashire, "Improvements in the manufacture of iron, and in the application thereof to certain useful purposes."

33. W. H. Atkinson, Aldersgate Street, London, "Improvements in the preparation and use of compositions for cleansing and sweetening casks and other vessels, such composition being also applicable to other purposes."—January 4, 1868.

39. E. R. Southby, Lanark, N.B., "Improvements in separating paraffin from its solutions, and in apparatus therefor."—January 6, 1868.

Spiller's Boiler Fluid, for the Prevention and Removal of Calcareous Incrustation from Steam Boilers, has been extensively employed for nearly ten years past in the Royal Arsenal at Woolwich, the Government Powder Mill, at Waltham Abbey, besides being used successfully by Railway Companies and in many private establishments.

The Fluid being perfectly miscible with water, may be introduced at any time into the boiler with the feed-water. It does not exert the slightest corrosive action upon the metal-plates or fittings of the Boiler, but, on the contrary, clears off any existing rust and preserves the iron from oxidation, whereby any flaws in the Boiler-plate become immediately apparent on inspection.

Directions for use accompany each package.

Price 2s. per gallon; in quantities of not less than 50 gallons, 1s. 9d. per gallon.

Prepared by J. B. BARNES, Manufacturing Chemist, 1, Trevor Terrace, Knightsbridge, S.W., Sole Agent for Spiller's Boiler Fluid.

Ozone.—Being the record of some Experiments and Observations on the nature of this interesting body; especially in its relations to Animal Charcoal, and the oxidation of Soluble Organic Matter, by THOS. WM. TOBIN. May be had through all Booksellers, or of the Author, by post, 8, Old Jewry, E.C.

8vo., Coloured Wrapper, 95 pp., price 1s.

Disinfection and the Prevention of Disease,
By HENRY BOLLMANN CONDY.

"Mr. Condy has enlarged upon his programme in a manner which will render his book acceptable both to the medical profession and the public at large. He appends special directions, among other things, for the testing of water for organic impurities, the purification of water, the testing and purification of the air of rooms, the ozonising of air, &c., by means of his fluid."—*Med. Times and Gazette.*

"The book deserves a more extended review than our limited space affords. This, however, we think it right to add, our conviction, viz., —that the alkaline permanganates, as purifiers, disinfectants, and deodorisers, are superior to any others we are yet acquainted with, and that they are perfectly fitted to accomplish, under the direction of man, in his limited sphere of action, what ozone effects in nature."—*Brit. and For. Medico-Chir. Review.*

London: Robert Hardwicke, 192, Piccadilly.

THE CHEMICAL NEWS.

Vol. XVII. No. 433.

ON

VANADIUM, ONE OF THE TRIVALENT GROUP OF ELEMENTS.*

By HENRY E. ROSCOE, B.A., F.R.S.

The metal vanadium (so-called from Vanadis, a cognomen of the Scandinavian goddess Freia) was discovered in 1830 by Sefström in the celebrated Swedish bar-iron made from the Taberg ore. From this source, even when using many pounds of the iron, Sefström obtained only minute quantities of the new substance, but he found it in somewhat larger amount in the slag or cinder produced in the reduction of the iron ore. Sefström ascertained some of the most peculiar characters of the substance, proved it to be a new element, and prepared some of its compounds in the pure state. The reactions by which vanadium can be separated and distinguished from all the other elements are: (1) The formation of a soluble sodium vanadate when the vanadium compounds are fused with sodium carbonate; (2) the formation of an insoluble ammonium vanadate when sal-ammoniac is added to the solution of a soluble vanadate; (3) the production of a splendid blue solution when this ammonium salt, dissolved in hydrochloric acid, is warmed with reducing agents such as oxalic acid.

Sefström not having leisure to prosecute the full examination of the properties of the new metal, handed over his preparations to Berzelius; and it is to the investigations of the great Swede (1831) that we owe almost all our acquaintance with the chemistry of vanadium.

Since Berzelius's time vanadium has been discovered in many minerals, of which a lead ore containing lead vanadate, and called by the mineralogists vanadinite, is the most important. It has also been found in many iron ores, in clay, bricks, and even in caustic soda. Still the quantity of the substance found in all these various sources has been extremely small; so much so, that the vanadium compounds must be reckoned amongst the chemical rarities, and we find them quoted in the price lists of dealers in chemicals at 1s. 6*d*. per grain, or £35 per ounce! It is clear that our knowledge of the chemical properties of a substance so rare must necessarily be but incomplete, as the difficulties of obtaining exact or satisfactory results with small quantities of material are evident; and, in fact, the statements of the only persons who have worked upon the subject recently (Schafarik Czudnowicz), instead of giving us any more reliable information respecting the character of vanadium, have only served to throw doubt upon some of the conclusions of Berzelius, and thus to render our knowledge even less complete than it appeared to be.

Hence it was with much satisfaction that, in February, 1865, the speaker came into possession of a plentiful source of vanadium in a by-product obtained in the preparation of cobalt from the copper-bearing beds of the lower Keuper-sandstone of the Trias at Alderley Edge, in Cheshire. The manager of the works was puzzled to know why a blue solution, supposed by him to contain copper, did not deposit the red metal upon a strip of zinc; the speaker recognised this reaction as due to the presence of vanadium, and secured the whole of the by-product, which he found to contain about 2 per cent of the rare metal. The exact position of the vanadium mineral in the sandstone beds cannot now be stated, as the mine (at Mottram St. Andrews) from which the cobalt ore was obtained, is now closed, and cannot be entered. The general characters of the deposit are, however, well known, and exhibit points of great interest; they have been well described by Mr. Hull as follows:—

"The 'edge' or escarpment of Alderley rises from the eastern side of the plain of Cheshire gradually towards the east, but with a steep and abrupt ridge towards the north. This northern bank is richly wooded, and has a very beautiful aspect when viewed from a distance, as it contrasts strongly with the almost level plain which sweeps away to the northward and westward from its base. The ridge has here been upheaved along the line of a large fault, bearing east and west, throwing down at its base the Red Marl; and on the other side bringing up the soft sandstone of the Bunter, capped by a mural cliff of Lower Keuper conglomerate, which often breaks out in conspicuous masses through the foliage. The beds rise from the plain towards the east at an angle of about from 5° to 10°, and the escarpment is continued southward for some distance facing the east."

Succession of Beds in Descending Order.—(*Hull.*)

Red marl		Red & grey laminated marls.
Waterstones .. Freestone .. .. Copper-bearing sandstone .. Conglomerate ..	Lower Keuper sandstone, 500 feet.	Brownish flaggy sandstones and marls. White and brown freestone. Soft white, yellow, and variegated sandstone. Hard quartzose conglomerate, underlain by bands of Marl, forming the base of the Keuper sandstone.
Upper red and mottled sandstone	Bunter.	Soft fine-grained yellow and red sandstone, being the uppermost member of the Bunter sandstone.

The beds in the above series which claim the greatest share of our attention are those at the base of the Keuper series, for in these occur the copper and other minerals. The copper, as both blue and green carbonate, occurs disseminated throughout the sand, the ore coating the outside of the grains of sand and the pebbles of quartz. In addition to copper, bands containing lead both as carbonate and sulphide (galena) occur, also bands and veins of cobalt ochre, oxide of manganese, and iron ochre in workable quantity. The copper is extracted from the ore by solution in hydrochloric acid and precipitation as metal by scrap iron. The ordinary copper liquor, as well as the oxide of iron precipitated by lime from the solution of the chloride, does not contain any trace of vanadium, nor was the speaker able to detect any of this metal in the ore as at present worked.

Following, in the main, the process of preparation adopted by Sefström, the speaker obtained from the above-mentioned lime precipitate several pounds of pure ammonium vanadate, from which all the other compounds of vanadium can be prepared.

What now were the conclusions to which Berzelius arrived from his experiments concerning the constitution of the vanadium compounds? He corroborated Sefström's statement, that the most characteristic feature of the substance is the existence of an acid-forming oxide, termed vanadic acid, produced whenever any of the oxides are heated in the air. Berzelius also discovered two other oxides of vanadium, of which he ascertained the composition; and likewise a volatile chloride. To the highest oxide he gave the formula VO_3, to the second

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* Read before the Royal Institution of Great Britain, Friday, February 14th, 1868.

VO_2, and to the lowest (or suboxide) VO; whilst the chloride was represented by VCl_3. The atomic weight of the metal he ascertained to be V = 68·5. Berzelius came to this conclusion from the following experimentally ascertained facts: (1) That on passing hydrogen over heated vanadic acid a constant loss of weight occurred, and the suboxide was formed; (2) that when dry chlorine is passed over the suboxide thus prepared, the volatile chloride was formed, and a residue of vanadic acid remained, which was exactly equal in weight to one-third of the acid originally taken for reduction. Hence assuming that the lowest oxide contains one atom of oxygen (an assumption borne out by the analysis of the chloride), the acid must contain three atoms of oxygen,[*] and the following formulæ represent the composition of these compounds according to Berzelius:—

$$VO \quad VO_2 \quad VO_3 \quad VCl_3 \quad (V = 68{\cdot}5).$$

The interest attaching to the conclusions which Berzelius fairly drew from his experiments was much heightened by an observation made by Rammelsberg in 1856, as to the exact crystalline form of the mineral vanadinite, a double salt of lead vanadate and lead chloride.

So long ago as 1780 Werner had observed the identity of crystalline form of two minerals, viz., apatite, a phosphato-fluoride of calcium, and pyromorphite, a phosphato-chloride of lead; to which may be added, mimetesite, an arsenato-chloride of lead. These minerals all have an analogous composition, being represented by the formulæ:—

Apatite $3(Ca_3P_2O_8) + CaFl_2$
Pyromorphite $3(Pb_3P_2O_8) + PbCl_2$
[†]Mimetesite $3(Pb_3As_2O_8) + PbCl_2$.

They are truly isomorphous, crystallising in hexagonal prisms, terminated with hexagonal pyramids, having the same angles and the same length of axes. Rammelsberg added to this list the mineral vanadinite, which he ascertained by measurement to be strictly isomorphous with the foregoing, and to be as follows. The angle P on P was in

1. Vanadinite	142°30'
2. Apatite	142°20'
3. Pyromorphite	142°15'
4. Mimetesite	142°7'

and the relation of the length of the axis:—

1. 1 : 0·727 | 3. 1 : 0·736
2. 1 : 0·732 | 4. 1 : 0·739.

So far, indeed, has the identity of crystalline form been traced, that crystals have been found which at one end consisted of vanadinite, and at the other of pyromorphite (Heddle). Now judging from the crystallographic analogies alone, we should conclude that the formula of vanadinite is

$$3(Pb_3V_2O_3) + PbCl_2.\text{‡}$$

the oxide of vanadium contained in the mineral having a formula V_2O_5, agreeing with the corresponding oxides of phosphorus and arsenic, P_2O_5 and As_2O_5. In making this assumption, we are, however, at once confronted with the unyielding chemical facts of Berzelius, according to which the oxide in question must be represented by the formula VO_3, and contains three, and not five, atoms of oxygen.

It is, then, evident that we have here either to do with an exception to the law of Isomorphism, or else Berzelius's views are erroneous. Until this latter has been proved to be the case, chemists have, however, only been justified in assuming the former alternative to be the correct explanation.

The speaker stated that in order to endeavour to clear up this question, he had most carefully repeated Berzelius's experiments, and that he had confirmed them in every particular; but having pursued the subject further than Berzelius, he had at last come to conclusions concerning the constitution of the vanadium compounds totally different from those drawn by the Swedish chemist, and had succeeded in obtaining the key to the enigma presented by the above anomalous crystallographic relations.

The speaker has proved that the substance supposed by Berzelius to be vanadium, V = 68·5, is not the metal, but an oxide, and that the true atomic weight of the metal is 68·5 − 16 = 52·5 (or rather, according to the speaker's exact determinations of the atomic weight, 67·3 − 16 = 51·3).[*] The highest oxide, the vanadic acid, VO_3, of Berzelius, hence becomes a pentoxide, V_2O_5, corresponding to P_2O_5 and As_2O_5, and the isomorphism of vanadinite with the pyromorphite group of minerals is fully explained. The suboxide of Berzelius is a trioxide, V_2O_3, whilst the terchloride (VCl_3) of Berzelius is an oxychloride, having the formula $VOCl_3$, and corresponding to oxychloride of phosphorus, $POCl_3$. The oxide supposed by Berzelius to be the metal contains 51·3 parts by weight of vanadium to 16 parts by weight of oxygen, and the vanadic oxide of Berzelius also exists, containing 51·3 parts of the metal to 32 parts of oxygen; to these oxides the empirical formulæ V_2O_2 and V_2O_4 may be given. Thus we have the following as representing the true composition of these vanadium compounds:—

	Dioxide.	Trioxide.	Tetroxide.	Pentoxide.	Oxytrichloride.
V = 51·3	V_2O_2	V_2O_3	V_2O_4	V_2O_5	$VOCl_3$

Each of the four oxides can be obtained in the anhydrous state; the dioxide is prepared as a grey metallic powder, by passing the vapour of the oxytrichloride mixed with hydrogen over red-hot carbon. The trioxide is obtained by the reduction of vanadic acid in a current of hydrogen, and the tetroxide is formed by the slow oxidation of the trioxide.

The lowest or dioxide of vanadium (V_2O_2) is obtained in solution by the reducing action of nascent hydrogen evolved from zinc, cadmium, or sodium amalgam upon the sulphuric acid solution of vanadic acid, which, passing through all stages of blue and green colour, ultimately assumes a permanent lavender tint. This solution of V_2O_2 in sulphuric acid acts as a most powerful reducing agent, bleaching indigo solution and other vegetable colouring matters as rapidly as chlorine; it also absorbs oxygen with avidity from the air, forming a deep brown solution. The other oxides of vanadium may be obtained in solution by the action of various reducing agents on the sulphuric solution of vanadic acid. Thus, by the action of nascent hydrogen evolved from magnesium a permanent *green* tint is obtained, and the vanadium is contained in solution as the trioxide, V_2O_3; whilst if moderate reducing agents, such as sulphurous acid, sulphuretted hydrogen, or oxalic acid are employed, the colour of the liquid does not pass beyond the *blue* stage, and the

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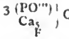
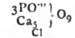
[*] Berzelius concludes that the acid does not contain two atoms of metal, inasmuch as no alum could be formed with potassium sulphate corresponding to those formed by well-known sesquioxides.

[†] This group of minerals may be considered as calcium triphosphofluorhydrine, &c., thus:—



$$\left.\begin{array}{c}3(PO''')\\ Ca_5\\ F\end{array}\right\} O_9$$

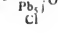
Apatite.



$$\left.\begin{array}{c}3PO'''\\ Ca_5\\ Cl\end{array}\right\} O_9$$

Pyromorphite. (*Wurtz.*)

[‡] Or lead trivanadochlorhydrine



$$\left.\begin{array}{c}3VO'''\\ Pb_5\\ Cl\end{array}\right\} O_9$$

[*] In his paper on Vanadium, read before the Royal Society (Dec. 19, 1867), the author ventured to predict that the difference between the number he obtained (67·3) and that found by Berzelius (68·5) was probably owing to the fact that the vanadium compounds employed by Berzelius contained traces of phosphorus, which render the perfect reduction of the vanadic acid in hydrogen impossible. Most fortunately this supposition has been singularly verified, inasmuch as Dr. Frankland has kindly placed in the speaker's hands a small specimen of vanadiate of ammonia found in Faraday's collection, and labelled, "Sent to me by Berzelius, 1831." On examination, this sample was found to contain considerable quantities of phosphorus, thus confirming the speaker's previously expressed opinion.

vanadium is contained in solution as tetroxide, V_2O_4.* The different colours of solutions containing these oxides was exhibited by means of the magnesium light.

The fact that the lemon-coloured chloride (the terchloride of Berzelius) contains oxygen was clearly demonstrated during the discourse by passing the vapour from a few grammes of the substance, together with perfectly pure hydrogen gas, over red-hot carbon. A portion of the oxygen of the oxychloride unites with the carbon to form carbonic acid, and the presence of this gas was shown by the precipitation of barium carbonate in clear baryta water contained in two test-tubes placed one before the other. At the commencement of the experiment, the carbonic acid was entirely absorbed by the small quantity of baryta water contained in the first test-tube; but after some time the hydrochloric acid gas simultaneously produced by the decomposition of the chloride saturated this liquid, expelling the carbonic acid gas, which being carried forward into the second test-tube, threw down a bulky precipitate of barium carbonate, thus showing that the turbidity cannot possibly be due to the presence of any vanadium compound. It was found quite unnecessary to place a tube containing heated copper oxide after the red-hot carbon, for the purpose of oxidising any carbonic oxide gas which might be formed, inasmuch as carbonic acid was always left in sufficient quantity to give a considerable precipitate. No method has been found for separating the whole of the oxygen from the oxychloride, and hence it has been impossible to make the above experiment quantitatively. Solid oxychlorides are obtained by the action of hydrogen upon the oxytrichloride, one of which resembles mosaic gold, possessing a bright metallic bronze-like lustre, and having been taken for the metal by Schafarik.

The atomic weight of vanadium was determined (1) by reducing the pentoxide to trioxide in a current of hydrogen. (2) By the analysis of the oxytrichloride. The atomic weight obtained as the mean of a large number of well-agreeing experiments is 51·3.

The metal itself has not yet been obtained, but a compound of vanadium and nitrogen has been prepared, shown by direct analysis to contain 14 parts by weight of nitrogen to 51·3 parts by weight of vanadium, corresponding to the formula VN. The existence of this compound is proof positive of the true atomic weight of the metal, and the nitride serves as the point of departure from which to seek for the metal and the true chlorides of vanadium, one of which, VCl_3, has already been prepared by the action of chlorine upon the nitride. It is a dark brown liquid, which decomposes when thrown into water, forming a green solution containing V_2O_3. The speaker demonstrated the fact that the oxychloride, $VOCl_3$, when thrown into water decomposes with formation of a *yellow* solution of vanadium pentoxide, V_2O_5, whilst the trichloride, VCl_3, on being similarly treated yields a *green* solution containing the metal in solution as trioxide, V_2O_3. He then compared these reactions with the decomposition of the corresponding phosphorus compounds, $POCl_3$ and PCl_3, forming P_2O_5 and P_2O_3, and rendered these reactions visible by obtaining a precipitate of yellow silver phosphate in the first case, and of black metallic silver in the second.

The characters of the vanadates themselves bear out the analogy of the highest oxide with the corresponding oxides of phosphorus and arsenic. In the first place, all the naturally occurring vanadates are tribasic; secondly, the true character of vanadic acid is shown to be tribasic, by the fact that, when the pentoxide is fused with sodium carbonate, three atoms of CO_2 are liberated, and the normal or orthovanadate, $Na_3V_2O_8$ (corresponding to $Na_3P_2O_8$), is formed; thirdly, the so-called monovanadates are monobasic salts, corresponding to the monobasic phosphates, and may be termed metavanadates, thus, $Na\,V\,O_3$ and $Ba\,2\,V\,O_3$, whilst the so-called bi-vanadates are anhydro-salts.

All the reactions by which Berzelius explained the facts he discovered, can equally well be represented according to the new atomic weight and constitution; thus:—

BERZELIUS'S FORMULÆ.

$$V = 68{\cdot}5 \quad O = 8$$

$$1)\ VO_3 + H_2 = VO + H_2O_2$$

$$2)\ 3\,(VO) + Cl_6 = VO_3 + 2\,(VCl_3)$$

NEW FORMULÆ.

$$V = 51{\cdot}3 \quad O = 16$$

$$V_2O_5 + 2H_2 = V_2O_3 + 2\,(H_2O)$$

$$3\,(V_2O_3) + 6\,Cl_2 = V_2O_5 + 4\,(VOCl_3).$$

The speaker stated that the foregoing facts clearly pointed out that vanadium, hitherto standing in no definite relation to other elements, must be regarded as a member of the well-known trivalent or triad class of elementary substances, comprising nitrogen, phosphorus, boron, arsenic, antimony, and bismuth.

It is true that we are still but imperfectly acquainted with many of the characters of vanadium, but the more its nature is studied, the more points of family resemblance will be discovered, and the more close will the ties be found, which bind it to the great triad family.

The following tabular statement of the compounds of the most important members of this group clearly shows their common relations:—

TRIVALENT GROUP OF ELEMENTS.

	Nitrogen.	Phosphorus.	Vanadium.	Arsenic.	Antimony.
	$N = 14$	$P = 31$	$V = 51{\cdot}3$	$As = 75$	$Sb = 122$
Trihydrides ..	NH_3	PH_3	—	AsH_3	SbH_3
Trichlorides ..	NCl_3 (?)	PCl_3	VCl_3	$AsCl_3$	$SbCl_3$
Pentachlorides	—	PCl_5	—	—	$SbCl_5$
Oxychlorides	—	$POCl_3$	$VOCl_3$	—	—
Monoxides ..	N_2O	—	—	—	—
Dioxides.. ..	N_2O_2	—	V_2O_2	—	—
Trioxides ..	N_2O_3	P_2O_3	V_2O_3	As_2O_3	Sb_2O_3
Tetroxides ..	N_2O_4	—	V_2O_4	—	Sb_2O_4
Pentoxides ..	N_2O_5	P_2O_5	V_2O_5	As_2O_5	Sb_2O_5

In conclusion, the speaker remarked that vanadium was the fourth substance, supposed by its discoverer to be a metal, which had in recent years been shown to be a compound body.

Titanium.	Uranium.	Niobium.
Wollaston, 1823.	Klaproth, 1789.	Hatchett, 1801.
Wöhler, 1849.	Peligot, 1849.	Rose, 1842-64.
		Marignac, 1865.

Vanadium.
Sefström and Berzelius, 1831.

Trimethylamine in Wine.—White Austrian wine, according to E. Ludwig, contains trimethylamine, which the author isolated in the following way:—The wine was freed from alcohol by distillation, then again distilled with a solution of sodic hydrate, the alkaline distillate neutralised with sulphuric acid, and evaporated. The residual salts, containing much ammonic sulphate, were extracted with absolute alcohol, the alcoholic solution evaporated, and the residue again distilled with sodic hydrate. From this distillate, the platino-chloride was prepared, and identified as that of trimethylamine.—(*Akad. z. Wien.*, 56, 1857.

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* In his communication to the Royal Society (Bakerian Lecture, Proc. Royal Soc. xvi. 220), the author gave the empirical formula VO and VO_2 to the 1st and 3rd oxides of vanadium, as the molecular weights of these oxides have not been determined, and it is uncertain whether they obey the law of even atomicities, or, like the only corresponding compounds, the nitrogen oxides, are exceptions to this law. On consideration, the author has, however, thought it best to adopt the doubled formula as urged by Sir Benjamin Brodie on the occasion above referred to.

CONTRIBUTIONS TO OUR KNOWLEDGE OF THALLIUM.*

By Prof. Dr. J. W. GUNNING.

One of my former pupils, M. Serrurier, now managing director of the Amsterdam soda manufactory, had the kindness to make me a present of the flue dust obtained at the works where the pyrites used for making sulphuric acid is derived from the neighbourhood of Suhrort. I found this flue dust to yield about 1 per cent of chloride of thallium; the bulk of the dust is made up of arsenious and arsenic acids, some iron and lead, but hardly any sulphuric acid. It is usual in order to obtain thallium from this dust to boil it (the dust) with dilute sulphuric acid, to strain, and to precipitate the thallium by means of hydrochloric acid; the chloride of thallium so obtained is washed, and afterwards dissolved in strong sulphuric acid, yielding the well crystallising sulphate of thallium. Another plan is to digest the flue dust with a solution of carbonate of soda, and to precipitate the thallium by means of hydrosulphuret of ammonium. It has struck me while engaged with this matter that neither of these methods answer the purpose well; the sulphate and carbonate of thallium are not very readily soluble, and unless therefore one is prepared to lose a portion of thallium, there is no end of boiling the flue dust with solvents. One must, moreover, bear in mind that the flue dust contains a portion of the thallium as peroxide, insoluble in soda, and indifferently soluble only in dilute sulphuric acid. The presence of Tl_2O_3 in flue dust is proved in this way: after long treatment with soda solution there is a brownish muddy mass left, which, when acted upon by sulphurous acid dissolved in water, becomes partly discoloured and yields a large proportion of sulphate of thallium.

I have applied phosphoric acid to extract thallium from the flue dust, and I find it answer admirably well. The phosphates of thallium, and especially so the acid phosphate, are among the most soluble of the salts of thallium. Since phosphoric acid itself is rather too expensive to be thus applied, I have substituted therefore a mixture of bone ash and sulphuric acid, which answered the purpose splendidly; it is only required to digest and heat the mixture of flue dust and bone ash with sulphuric acid, and some water, a sufficiently long time, to render a twice repeated digestion quite efficient to remove from the flue-dust I had obtained, all the thallium it contained, amounting to about 1 per cent of the whole mass; of course the filtrate was treated with hydrochloric acid. The fluid from which the chloride of thallium had been separated by filtration, contained, however, yet a considerable amount of thallium dissolved, partly so in consequence of the non-thorough insolubility of chloride of thallium, partly also as thallic salts not precipitable by hydrochloric acid; in order to obtain this portion sulphite of soda is added to the acid liquid, whereby the thallic salts are reduced to thallous salts, next the acid is pretty nearly neutralised with carbonate of soda, and the thallium compounds afterwards precipitated by iodide of potassium as insoluble yellow iodide of thallium.

The best and easiest plan to convert crude chloride of thallium into pure salts of thallium is this, that, after washing with water acidulated with some hydrochloric acid (since pure water dissolves a larger proportion of the chloride) the chloride is peroxidised. This I perform in the following manner: Place in a porcelain basin a moderately concentrated solution of carbonate of soda, pass a powerful current of chlorine gas through it, and stir meanwhile in the chloride of thallium by small quantities at the time; the decomposition is instantaneous, and the chloride of thallium soon quite converted into black peroxide. If the quantity of chloride of thallium which has to be thus acted upon is somewhat large, it is requisite to take a fresh quantity of soda solution, since it is clear that the solution must not become acid. One may rest assured that there is no loss of thallium when after the operation is finished the liquid is yet alkaline, and contains free chlorine (hypochlorites). The peroxide of thallium should be first washed by decantation, afterwards on a filter, it is next diffused through a small quantity of water, through which a stream of sulphurous acid gas is passed, whereby it (the peroxide of thallium), becomes dissolved as sulphate of thallium; this latter salt is most readily obtained in the crystalline state by allowing its solution spontaneously to evaporate placed under a desiccator. This mode of operating is far preferable to that of decomposing chloride of thallium by strong sulphuric acid, whereby beside the inconvenience of acid vapours, also is experienced some difficulty in consequence of the slowness and somewhat difficultly attainable completeness of the process. I have found that crude chloride of thallium always contains arsenic, even when the precaution is taken to precipitate that salt from a dilute and perfectly clear solution; I think this is due to the fact that the precipitated chloride of thallium, carries down along with it arseniate of thallium mechanically. Since the flue dust contains arsenic acid as well as arsenious acid, the former of these is the cause why crude chloride of thallium, dissolved in sulphuric acid, always yet contains arsenic.

It is a known fact that when arsenious acid is heated in the presence of chlorides and sulphuric acid, there is formed $AsCl_3$, which, however, does *not* take place with arsenic acid. The sulphuric acid solution, while submitted to Marsh's test, exhibits quite plainly the well-known reaction for arsenic; but, on the other hand, on being treated with H_2S, yields a beautiful, brownish-red, very flocculent precipitate, which might be taken to indicate antimony, although I thoroughly verified the absence of that metal in every way. It has been asserted by some chemists that there exists a reddish, or brown-reddish coloured higher sulphuret of thallium insoluble in dilute acids, but a rather instable compound. The substance just alluded to is no doubt that sulphuret, of the existence of which one may easily satisfy one's self by treating dry sulphate of thallium with *aqua regia*, or by boiling the sulphate of thallium with sulphuric acid and peroxide of lead, or of manganese; the solution of the thus partly-oxidised sulphate yields, on being submitted to a current of H_2S, in the first instance, a brownish-red precipitate, which, however, gets soon after dissolved, while sulphur is deposited; H_2S reduces also the thallic salts to thallous salts. I have not succeeded in obtaining this sulphuret under conditions of greater stability.

Böttger, *Ann. der Chem. u. Pharm.*, cxxviii., p. 249, speaks of this sulphuret, which, according to his researches, should be a higher sulphuret of thallium mixed with sulphide of arsenic and free sulphur; he also mentions that the said compound may be obtained in pure state by treating an acid thallic salt with a rather small quantity of hyposulphite of soda. I consider this last assertion to be highly improbable, since even sulphurous acid so readily reduces thallic salts to thallous salts. On repeating the experiment with a solution of the chloride or sulphate of thallium, and addition of some hyposulphite of soda, I have seen nothing but a separation of sulphur. I cannot, however, consent to agree to the opinion that the sulphuret in question should just be a higher sulphuret, for the following reason:—I found that the solution of the crude chloride of thallium in sulphuric acid, after having been treated with a current of sulphurous acid in excess, and afterwards with H_2S, just again yields the same reddish-brown precipitate. The following reactions justify the opinion that the brownish-red precipitate is a peculiar sulphide of thallium; strong bases readily convert it into black sulphide of thallium TlS_2, while sulphuret of arsenic becomes dissolved in the alkaline lye, and is re-precipitated therefrom on addition of an acid, as yellow As_2S_3, without simultaneous

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* Translated by A. Adriani, M.D., Ph.D., &c.

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precipitation of sulphur, and also without disengagement of H_2S, which latter occurrence could not have failed to take place if one had had to deal in this instance with a higher degree of sulphuration than As_2S_3, or Tl_2S; its behaviour on being heated, whereby a sublimate is obtained partly of As_2S_3, partly of As_2O_3, while at the same time black sulphuret of thallium remains as a molten mass; it is easy to obtain at will the very selfsame precipitate from every thallous solution by simply adding to it, first, some arsenious acid, then to pass through a current of H_2S, while it does not in the least matter whether the fluid is acid or has been rendered alkaline by ammonia; the said precipitate also occurs when an ammoniacal solution of As_2S_3 is precipitated with an ammoniacal solution of a thallous salt; from these results I draw the inference that I had simply to deal in this case with a mixture of As_2S_3 and Tl_2S. Analysis has proved this to be quite correct; the substance does not contain anything else than arsenic, thallium, and sulphur, while the latter is present in the proportion required to form Tl_2S and As_2S_3. My assistant, Mr. Adriaanz, performed the analysis in different ways: 1st. The substance weighed in a small flask was treated with a solution of pure caustic potassa, quite free from any sulphuric acid [sulphate], chlorine gas was passed through, and after a while the matter was entirely dissolved; from this solution pure carbonate of potassa free from sulphate, precipitated Tl_2O_3, this, after having been well washed upon a filter, was dissolved in sulphurous acid, next evaporated to dryness, again re-dissolved and precipitated with iodide of potassium as insoluble iodide of thallium, then dried and weighed. In the filtrate from Tl_2O_3 the sulphuric acid was determined in the usual way, and the arsenic As_2O_5 as ammonio-magnesian arseniate. This mode of proceeding always gave the arsenic too low. 2nd. The same method was applied, with this difference: that in order to prevent loss of arsenic, iodine was used instead of chlorine to effect the oxidation; the excess of iodine was eliminated by evaporation along with alcohol; by this process, however, it was found that a portion of the sulphide of thallium was not properly oxidised, in consequence whereof the result for S was found too low. 3rd. The substance was oxidised with pure nitric acid, or pure *aqua regia*; the sulphur which partly escaped oxidation, was weighed in that state, after having eliminated the excess of acid by evaporation; the thallic salt was, after addition of some potassa, precipitated by means of iodide of potassium; the iodine which hereby separated was eliminated by evaporation along with alcohol, the iodide of thallium separated by filtration, and As and S estimated as just described. While executing these operations, my assistant experienced great difficulty in obtaining a complete reduction of the thallic salt, in consequence whereof the iodide of thallium did not present its usually bright, splendid yellow colour, but was always somewhat blackish; it was, moreover, very difficult to remove from the filter, whereupon the sulphur had been collected, some thallic salt tenaciously adhering to both sulphur and filter. As a sequel of these difficulties, the estimation of the different compounds did not take place from one and the same weighed quantity, but care was taken to estimate all compounds in samples obtained by one and the same preparation. After it had been duly ascertained that on being heated above 100°C., the substance did not lose any more water, the samples submitted to analysis were dried at 100°C. Dried at that temperature the substance is found to be a readily mobile very light powder which, on being rubbed, becomes electrified. The following are the results obtained on analysis:—Tl = 204.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Sulphur ..	18·82	19·56	21·27	26·75	18·14	24·66
Arsenic ..	21·40	21·56	20·08	—	—	26·00
Thallium ..	60·57	57·07	58·65	41·52	67·33	46·27
.	100·79	98·19	100·00			96·93

Nos. 1—3 have been prepared by passing a current of H_2S through a solution of arsenious acid and sulphate of thallium in excess, acidified with sulphuric acid. The wash water ought to be mixed with an aqueous solution of H_2S, since otherwise the filtrate becomes somewhat coloured.

No. 4. prepared by mixing an ammoniacal solution of As_2S_3 with excess of an ammoniacal solution of sulphate of thallium, and afterwards addition of sulphuric acid until acid reaction ensues.

No. 5, prepared by adding to an excess of an ammoniacal solution of As_2S_3 an ammoniacal solution of sulphate of thallium.

No. 6, prepared as No. 5, but in reversed order, *i.e.*, thallium in excess. I am quite aware that these analyses exhibit some imperfections due especially to the difficulty quite correctly to estimate As, but more so yet Tl; this, however, is demonstrated that from acid solutions containing thallium in excess, is obtained a combination made up of equivalent proportions of sulphide of arsenic and sulphide of thallium. The calculated result of this compound As_2S_3, Tl_2S, is the following:—

Sulphur	18·7
Arsenic	21·9
Thallium	59·4

Ammoniacal solutions do not yield a compound of constant composition; even while being prepared the washings run off coloured, while the precipitate itself is evidently decomposed by ammonia. When a current of H_2S is passed through a solution containing equivalent proportions of As_2O_3 and Tl_2SO_4, only a small proportion of thallium is thrown down along with an excess of As_2S_3. If the quantity of As_2O_3 is increased above that of Tl_2SO_4, yet thallium remains in the solution, even a large excess of arsenic is incapable of assisting in throwing down the whole of the thallium; this, notwithstanding all these different precipitates, exhibits the same bright reddish-brown colour. In consequence of this somewhat singular behaviour, I, for a moment, suspected that some peculiar variety of the thallium salt might perhaps exist. I soon found, however, that if a solution of a salt of thallium is treated with As_2O_3 and H_2S, and this operation is repeated with the same solution of thallium, a second time a loss of metal is experienced, and that by repeating the same operation with the same sample over and over again, at last all the thallium is eliminated. I do not think it is possible to assign to this red substance a place among the well defined compounds. I do not know of another instance of similar composition and origin. It appears to me that the most probable explanation may be the following: To assume that beside the black sulphuret of thallium there exists another sulphuret of the same composition, but of different colour (akin to what is well known to be the case for mercury and antimony), and that this modification of the sulphuret of thallium is perhaps crystalline, and hence more apt to resist the action of acids, and that, furthermore, this compound formed as has been explained, can unite with sulphuret of arsenic, and form a molecular compound therewith. But even this explanation leaves unanswered the question which can be asked, How is it that the sulphuret of arsenic, the presence of which, and aptitude to combine with this red sulphide of thallium, is the cause of the origin of the latter, does not act in proportion of its quantity present in a given solution, but only transforms a comparatively small proportion of the thallium present into that compound?

The chemical history of this red substance teaches us that thallium cannot be separated from arsenic by means of H_2S, a point of some importance in quantitative analysis, as well as while operating on the flue dust from sulphuric acid works. It also deserves notice that the orange-yellow colour often exhibited by sulphur obtained from pyrites, and which is usually accounted for by ascribing that colour to the presence of selenium, may be equally well due to such sulphur containing thallium. I beg leave to state in connection herewith, that Mr. Wm. Crookes, the discoverer of thallium, found in crude sulphur obtained from Spanish pyrites 0·29 per cent of thallium. Mr. Crookes, however, did not record what colour this sulphur exhibited.*

A NEW ASPIRATOR.

By J. LANDAUER.

Though a number of aspirators of different construction are proposed and used in chemical analysis, the following may be added to the number as being distinguished by great simplicity. This new aspirator is based on the principle of the siphon. A capacious flask is hermetically closed by a cork provided with two holes. One of the latter receives the siphon, and the other a glass tube for connecting the apparatus, through which the passing of a current of air is desired. After having made the connections and filled the flask with water, the latter is made to run out of the flask by sucking the outer leg of the siphon, the end of which must, of course, be lower than the level of the water. The current of air is thus effected.

The efflux of water is regulated by joining more or less width to the tubes between apparatus and aspirator. Two aspirators are connected with the apparatus, and used alternately, in order to enable a refilling of the flasks without interruption of the process. For this purpose an intermediate apparatus, consisting of a glass tube about two inches long, and one inch wide, is required, which is connected on one side with the apparatus intended for receiving the current of air, and on the other side with the two aspirators. The latter connection may be effected by india-rubber tubes, each provided with Mohr's pinchcock. Such arrangement will enable the alternate working of the two aspirators. It is of course understood that all the connections must be effected hermetically. One of the advantages of this aspirator is that it allows an easy determination of the quantity of air passed through by employing graduated vessels.

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL SOCIETY,

Wednesday, March 4th.

H. **Sugden Evans**, Esq., Vice-President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

Specimens of crab oil, cayenne pepper in olive oil, and other interesting drugs from British Guiana and New South Wales, were presented to the museum by P. L. Simmonds, Esq.

The **Chairman** directed attention to a spurious jalap, from New York, 16 bales of which had been offered at a public sale, but was not purchased. He thought it was the rose-scented jalap, and previous to the meeting he had shown it to Professor Bentley, who thought it bore a great resemblance to the specimen of rose-scented jalap in the museum.

Mr. D. **Hanbury**, F.R.S., who read a paper a short time since "*On the Cultivation of Medicinal Plants,*" mentioned that he very recently dug up a root of jalap from his father's garden, at Clapham, which was planted last June twelvemonth. It had remained in the open ground during the winters of 1866 and 1867. One tuber had produced six large tubers and twenty-four small ones. He thought it grew better in the open air than under glass. Unfortunately the flowering was too late for the seeds to ripen. This circumstance goes far to prove that jalap might be cultivated in Europe with ordinary attention.

In reply to the Chairman and Mr. Morson, Mr. Hanbury said that he was not prepared to speak of the properties of the jalap, not having tested it sufficiently.

Mr. **Umney** had examined the specimen of jalap from New York, on the table, and thought it differed from the rose-scented jalap in the museum: it possessed a peaty odour which the other did not.

Professor **Attfield** then read a paper "*On the Analysis of the Water of a Remarkable Medicinal Spring in Jamaica,*" which he had received for analysis in May, 1867. It had been sent from Jamaica with the statement that thousands of the negroes had for weeks flocked to the spring, thinking it was a cure for all diseases. It was clear, inodorous, and strongly alkaline to the taste, its specific gravity being 1026·6. An imperial gallon contained 2493½ grns. of solid matter, which is about the average amount of saline compounds in sea water, but the author thought that spring water containing so much mineral matter had never been known. The constituents in one gallon were:—

Chloride of calcium	1510·00 grs.
Chloride of sodium	981·00 ,,
Chloride of ammonium	2·43 ,,
Water..	69368·57 ,,

So that a gallon contained about 3½ oz. of chloride of calcium, 2 oz. of salt, and 2½ grs. of chloride of ammonium. Dr. Attfield had tested it for sulphates, nitrates, carbonates, potassium and magnesium salts, bromides, iodides, fluorides, sulphides, phosphates, nitrites, silicates, borates, and a number of other salts, but found none, and animal and vegetable matter were also absent. The proportion of chloride of calcium he believed to be unprecedented. There was another spring in Jamaica of a thermal character, which contains 105 grs. of chloride of calcium to the gallon; the saline and chalybeate water of Harrowgate contains between 120 and 130 grs. of chloride of calcium; and the water of the Dead Sea, 25 per cent of which was stated to be solid matter, also contained a little chloride of calcium. The gases dissolved in the water were small in amount—one gallon contained 3·33 cubic inches of nitrogen, 1·55 of oxygen, and ·50 of carbonic acid. In sending the result of the analysis to Jamaica, Dr. Attfield asked the proprietors of the estate to send him some information on the history of the spring and topography of the district, thinking it would be of geological as well as chemical and physiological interest. From the report he had received it would appear that the water had been used for medicinal purposes upwards of forty years. The negroes believed it a cure for every disorder, but it was chiefly used for scrofulous affections, glandular swellings, &c. The author quoted from Pereira's statement of the therapeutic action of chloride of calcium, which shows that it is most useful in those diseases for which the negroes have recourse to the medicinal water. The spring is 68 ft. above the sea level, and 76 chains from it; temperature, 82°F.; and it makes its appearance in the diluvial gravel that nearly fills a small brook known as the Saint's Ann's Great River. Dr. Attfield presumed it was of volcanic origin.

The **Chairman** said they were very much obliged to Dr. Attfield for his paper, which contained a number of points of great interest.

Mr. C. H. **Wood** suggested that it might be used to water the road, as an artificial water was manufactured for that purpose.

Mr. C. H. **Wood** read a paper "*On the Syrup of Hypophosphite of Iron,*" in which he referred to the disadvantages of the processes given in the *Pharmaceutical Journal* (vol. vii. p. 440) and *Parrish's American Pharmacy*.

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* The colour varies between orange, red, and dark grey, according to the quantity of thallium present.—W. C.

He had made a good syrup, containing 2 grs. of hypophosphite of iron in 1 dram, by dissolving 480 grs. of granulated sulphate of iron in 1 ounce of dilute phosphoric acid and 1½ ounce of distilled water, then reducing 326 grs. of pure hypophosphite of lime to fine powder, adding to it the solution of sulphate of iron, and triturating before transferring to calico. The liquid was then pressed out, filtered, and mixed with seven times its volume of simple syrup.

The CHAIRMAN thanked Mr. Wood for his practical paper, and

Mr. UMNEY referred to a process for the preparation of the syrup which contained 1 gr. of hypophosphite of iron to the dram, but he thought Mr. Wood's process was an improvement.

Dr. ATTFIELD asked Mr. Wood if he had experienced any danger in preparing the hypophosphite of lime. He had heard of an explosion occurring, even when it was dried at a low temperature, 130 to 140°.

Mr. WOOD had not attempted to make any quantity, on account of phosphoretted hydrogen being evolved, which would prove an annoyance to the neighbourhood.

Professor REDWOOD had never heard of an explosion taking place in the preparation of hypophosphite of lime, but in preparing hypophosphite of soda it was necessary to dry at a very low temperature, to prevent an explosion.

Professor ATTFIELD described a laboratory experiment relating to "*Magnetic Hydrate of Iron.*" He had added an alkali to a solution of ferrous and ferric sulphate, in molecular proportions, and obtained the usual black hydrate of iron having the well-known property of being attracted by a magnet, even when the latter was simply immersed in the mixture. He then precipitated appropriate quantities of ferric hydrate and ferrous hydrate in separate vessels; neither of the precipitates was attracted by a magnet. The contents of the vessels were then well mixed, when a hydrate resulted, which at first was not at all magnetic, feebly attracted after ten minutes, its attractability slowly increasing until, after twenty-four hours, it appeared to be more strongly attracted than the black hydrate made in the usual way.

This experiment showed, first, that in making magnetic oxide of iron for use in medicine, fuel need not be wasted in obtaining ferric sulphate entirely free from the nitric acid used in its preparation, for the ferric solution could be poured into the alkali before the ferrous, any nitric acid thus becoming neutralised and prevented from oxidising the ferrous salt; second, it afforded confirmation, were any needed, of the view that magnetic hydrate was a compound and not a mere mixture of ferrous and ferric hydrates; third, it was a good illustration of the influence of time in chemical change.

Dr. REDWOOD thought that by boiling the solution, one would obtain a more certain and definite preparation.

The CHAIRMAN, after thanking Dr. Attfield for his communication, announced that the next meeting would be held on the 1st of April, when a paper would be read by Mr. C. H. Wood, and several laboratory experiments would be described.

The meeting was adjourned at an early hour.

Derivatives of Vinyl-Compounds.—Glinsky has studied the reaction between vinylic bromide and mercuric oxide, or hypochlorous acid (suggested by an analogous investigation by Linnermann, *vide* CHEMICAL NEWS, No. 428, 83), and obtained aldehyde, and a white amorphous body, which was found to be a compound of aldehyde and mercurous bromide of the formula—

$$\left.\begin{matrix} C_2H_3 \\ C_2HO_2 \end{matrix}\right\} + 2Hg_2Br.$$

—(*Zeitschr. Chem.*, N.F. iii., 675.)

FOREIGN SCIENCE.

PARIS, MARCH 17, 1868.

Colouring Principles in Madder.—Important Process in Dyeing.—Preparation of Uric Acid.—Extraction of Oils by means of Bisulphide of Carbon.—The Sesqui-fluoferrates.—ACADEMY OF SCIENCES: Production of Chlorine and Oxygen.—Products of the Slow Oxidation of Phosphorus.—Diffusion and Endosmose.—Mode of Action of Common Salt as a Manurial Agent.—Antiputrescent Properties of Sulphuric Ether.

SOME time ago madder formed the subject of a communication to the Société d'Encouragement, by M. Schützenberger. This communication has led the way to results of great interest, whether taken in a scientific aspect, or a pecuniary one. The existence of five pigments in this colouring matter, he had remarked, may be recognised—they are alizarine, purpurine, orange madder, pseudo-purpurine, and xantho-purpurine. These bodies are distinguished by their composition, their physical and chemical properties, and especially by their comportment in dyeing operations. Different samples of madder give, then, different results in dyeing, according to the predominance of one or other of the principles, and, as is well known, different tints according to the mordants used. Pseudo-purpurine is distinguished by its fugitiveness under the influence of soap; and the want of stability in the tinctures made from the madder of Alsace, is due to the presence of this principle in large proportion. M. Martin, observing these points in M. Schutzenberger's investigation, and knowing alizarine to be the only one of the five colouring matters yielding an unalterable dyeing material, essayed the transformation of the other principles into alizarine. The result has been that M. Martin has discovered a process by which purpurine, pseudo-purpurine, xantho-purpurine (yellow), and the orange-colouring matter can be transformed into alizarine: the process he has patented. This transformation is easily effected by the combined action of dehydrating and reducing agents. The colouring matters, either separately or mixed, are dissolved in concentrated sulphuric acid, and when dissolved, zinc is added. Elevation of temperature and a finely divided condition of the metal, facilitate the reaction. As soon as the transformation is considered complete, the mass is diluted with water, which gives rise to an abundant precipitate of alizarine; washing with water will render the matter ready for dyeing purposes. It will be interesting to compare the composition of the five principles occurring in madder, as given by M. Schützenberger:—

Alizarine	$C_{40}H_{12}O_{12}$
Purpurine	$C_{40}H_{12}O_{14}$
Orange madder	$C_{40}H_{16}O_{18}$
Pseudo-purpurine	$C_{40}H_{12}O_{18}$
Xantho-purpurine	$C_{40}H_{12}O_{12}$

The process of M. Martin would seem to be one of great importance.

Dr. Löwe has indicated the following method of preparing large quantities of uric acid from Peruvian guano. The guano is pulverised and dried at 100°C.; 1 part by weight is added in small quantities at a time to 1 part of sulphuric acid contained in a capsule, heated by a water bath, and stirred with a glass rod. The mixture is allowed to remain on the water bath as long as hydrochloric acid continues to be evolved. When the odour of hydrochloric acid is only slight, and the mixture seems homogeneous, 12 or 15 volumes of distilled water are added; this dilution causes a yellow precipitate, for the subsidence of which time is allowed. Afterwards the supernatant fluid is decanted off, the precipitate is washed with fresh quantities of water, thrown upon a filter, and the greater part of the sulphuric acid washed out. Small portions of this precipitate are now boiled in a weak solution of an alkali, the solution filtered and acidified with dilute hydrochloric acid to precipitate the uric acid, which appears as a yellow cloud. When cold, the precipitate is thrown on to a filter, washed, and dried. The yellow colour may be removed by heating with sulphuric acid at the temperature of a water bath, and repeating the process described; it is necessary to avoid adding more water in precipitating than is absolutely necessary, since the product is always yellow when excess of water has been used.

The extraction of oils by means of bisulphide of carbon is now carried on at Moabit, near Berlin, upon a very great scale. In the manufactory of M. Heyl, 2,570 kilog. of oil, of sufficiently good quality to be employed in lubricating machinery, are manufactured daily. Colza and linseed are the materials chiefly operated upon: the residues serve very well to feed cattle with. The seeds are first crushed and dried by heating. For the daily fabrication of 2,570 kilog. of oil, only six men are required. Analysis has shown the residues to contain only 2 per cent of oil and 7 per cent of water, while the residues of the ordinary pressure process contain 9 per cent of oil and 15 per cent of water. In the extraction of the oil, 7,000 kilog. of bisulphide of carbon are used daily, and the amount lost is 28 kilog.

M. Nicklès has published a paper on the sesquifluoferrates. The sesquifluoride of iron forms combinations with fluoride of sodium and ammonium; they are obtained in two ways, either by direct union of the sesqui fluoride of iron with the alkaline fluoride, or by decomposing the latter with sesquichloride of iron. The alkaloids also unite with this fluoride: combinations have been prepared with quinine and brucine. When the solutions of the ammonic and potassic fluo-salts are boiled, they are decomposed, depositing yellow flakes charged with iron. Ammonia separates sesquioxide of iron from these solutions: ferrocyanide of potassium causes a blue colouration, unless the solution contain an excess of alkaline fluoride. The colouration which is usually manifested is of a fine violet tint, quite different from the blue precipitate of prussian blue; it is capable of utilisation, M. Nicklès thinks, in the preparation of colours.

Among the memoirs brought before the Academy at the *séance* of the 24th of February, were the following:—A memoir on the production of chlorine and oxygen, by M. Mallett; on ozone and phosphoric acid, the result of the slow oxidation of phosphorus, from M. Blondlot; a memoir relating to diffusion, endosmose, molecular movement, &c., from M. Dubrunfaut; on the mode of action of common salt employed as a manure, by M. Jean; a note on the anti-putrescent properties of sulphuric ether, from M. Martin; analyses of some waters from the thermal springs of Ischia, near Naples, by MM. Mène and Rocca-Tagliato. The section of rural economy has presented the following list of candidates for the place vacant in it from the death of M. Rayer:—(1) M. Reiset; (2) MM. Bouley, Dubrunfaut, and Hervé Mangon; (3) M. Richard.

M. Mallett's memoir was an explanation of a process to which he called the attention of the Academy last year. He remarked that the fixation of the atmospheric oxygen upon protochloride of copper, permitted either of making the latter yield the oxygen, or yield chlorine upon addition of hydrochloric acid. The absorption of oxygen by protochloride of copper is spontaneous; the air being ordinarily moist, it will be complete in a few hours, if fresh surfaces be renewed. But elevation of temperature, and this is a main point, induces a much more rapid absorption: at temperatures between 100° and 200°, as well as at higher temperatures in the presence of water, this absorption may be considered as almost instantaneous. By this process 100 kilog. of chloride of copper (cuprous chloride), usually mixed with inert matter for convenience, will yield 3 to 3½ cubic metres of oxygen, or 6 to 7 cubic metres of chlorine, and as four or five operations may be made in four-and-twenty hours, this quantity, 100 kilog., would yield 15 to 18 cubic metres of oxygen, or 200 to 300 kilog. of chloride of lime, during the same time: the price of the chloride of copper does not exceed 1 franc the kilogramme.

When phosphorus undergoes slow combustion in air, it is generally considered, M. Blondlot says, that ozone and phosphorous acid are produced; these two bodies being incompatible, he thought the matter worthy of investigation. For this purpose, he took a flask of several litres capacity, closed with a cork carrying two tubes. One descending to the bottom of the vessel, communicated at the upper extremity, by means of a caoutchouc tube, with a reservoir of water furnished with a tap; the other was simply a curved tube for the delivery of the gas. In the ascending portion of this tube he placed a thin cylinder of phosphorus about 15 centimetres in length. This arrangement made, a fine jet of water was made to issue into the flask, when the air was expelled, bubble by bubble, between the phosphorus and the sides of the tube. The resulting gas, collected in the usual way, was washed at several intervals with water, until white vapours had completely disappeared. Two important facts have been demonstrated by the experiment. The first is, that if the ambient air should not attain vigourously 12°, when it leaves the apparatus, it will have acquired distinctly the characteristic odour of ozone, but it will not affect iodide of potassium and starch paper; while if the air of the apparatus is at 12° to 13°, these same papers, suspended in the receiving flasks, become as distinctly blue as if the temperature had been much higher. The second is that, whatever temperature one operates at, the white vapours which escape from the apparatus are composed exclusively of phosphoric acid, without admixture of phosphorous acid. There is no difference in the product after the greater part of the oxygen has been withdrawn from the air, this condition being attained by collecting the escaping gases in a flask over water, and then making the phosphorus undergo slow combustion in these collected gases. To be enabled to prove that phosphoric acid is the only product of combustion, it suffices to pass the escaping gases into distilled water. The solution, very distinctly acid, being exactly neutralised with potash, causes in nitrate of silver a yellow precipitate; it does not decolourise permanganate of potash, and introduced into a Marsh's apparatus, produces no green flame. This being so, it would seem curious why, in the class experiment, by the aid of which one obtains what was formerly called phosphatic acid (PO_3), there is produced phosphorous acid mixed with phosphoric acid. The explanation is simple. M. Blondlot has found that in a flask filled with a solution of phosphoric acid, to which a few pieces of phosphorus have been added, and corked, a portion of the phosphoric acid is speedily converted into phosphorous acid according to the equation $3PO_5 + 2P = 5PO_3$. From this it follows that when small sticks of phosphorus are exposed in narrow tubes to the action of moist air, the phosphorous acid produced is the result of a deoxidation of the higher oxide first produced. In conclusion, M. Blondlot states that, whatever be the rapidity of the combustion, when phosphorus undergoes combustion in air, phosphoric acid is the only product.

M. Dubrunfaut placed before the Academy a number of theorems relating to diffusion and endosmose. Among others, these:—Diffusion is always a molecular property, whether manifested with or without diaphragms (the first condition being considered endosmose, the second, diffusion). It is always accompanied by the double current, observed by Priestley and Dutrochet, and it is the result of an attractive force which is developed by the juxtaposition of molecules of matter of different kinds, or of molecules of matter in a different physical state. The effects of diffusion and endosmose are referable to one force—diffusion, which, though exerted at insensible distances, cannot be said to result from contact, since these distances are really great, and depend upon the finite dimensions of the molecules of the matter operated upon. The force of diffusion is always exerted in one direction, which is normal at the surface of contact of the fluids. It varies in intensity with different fluids, and with fluids of different densities, wherefore, also, with the temperature and pressure. Mechanical work in commensurable degree is performed. In fact, fluids which mix with great perfection offer with the displacement of their centres of gravity useful data wherewith to calculate the work performed in producing the mixtures.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Carbonic Oxysulphide.—C. Tran. This gaseous compound is formed; 1. By direct union of carbonic oxide with sulphur, at a low red heat; 2. By the action of dilute acids upon sulphocyanhydric acid:

$$\mathrm{CSNH + H_2O = NH_3 + CSO}.$$

By making use of the latter reaction large quantities of the new compound may easily be prepared. Powdered potassic sulphocyanide is added to a mixture, by volume, of 5 sulphuric acid and 4 of water, (in such proportions that the mass remains liquid), and the evolution of gas which sets in at once kept constant by alternately heating and cooling. The gas is purified from traces of cyanhydric acid (and formic acid), carbonic disulphide, and aqueous vapour, by letting it pass successively over mercuric oxide, non-vulcanised india-rubber, and calcic chloride. It may be collected over mercury when dry, without suffering change; water dissolves an equal volume, and gradually decomposes it. Its temperature of ignition is very low; it burns with blue flame; the products of combustion being carbonic anhydride, and sulphurous acid. Alkalic hydrates absorb it with formation of carbonate and sulphide. Its sp. gr. was found = 2·10.—(*Ann. Chem. Pharm.* 5 suppl. 236.)

Isomeric Compounds derived from Benzoic Acid.—H. Hübner and F. Mecker. The bromnitrobenzoic acids obtained from brombenzoic acid by the action of very strong nitric acid, at a moderate temperature, are best separated by extracting the mixture of acids repeatedly with insufficient quantities of boiling water, until the residue has become insoluble and infusible under water. (Those acids, derived from the insoluble portion, fusing at 248°C., are named *α*; those from the soluble, fusing at 140° *β* compounds.) *β* bromamidobenzoic acid,

$$\mathrm{C_7H_4Br(NH_2)O_2},$$

obtained by reduction of the corresponding nitro-compound with tin and chlorhydric acid in the proportions shown in the following equation:—

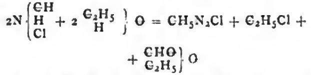
$$\mathrm{C_7H_4Br(NO_2)O_2 + 6Sn + 6HCl = 6SnCl + 2H_2O}$$
$$\mathrm{+ C_7H_4Br(NH_2)O_2}$$

crystallises in small needles, and fuses at 171 to 172°. *β* bromamidobenzoic acid, $\mathrm{C_7H_3Br(NH_2)O(OH)}$, crystallises in long needles, which are sparingly soluble, and fuse at 202 to 204°. *α* and *β* amidobenzoic acid, $\mathrm{C_7H_5(NH_2)O_2}$ and $\mathrm{C_7H_4(NH_2)O(OH)}$, which are obtained from their respective bromnitro-compounds by employing the following proportions:—

$$\mathrm{C_7H_4Br(NO_2)O_2 + 8Sn + 7ClH = C_7H_5(NH_2)O_2 + 7SnCl}$$
$$\mathrm{+ SnBr + 2H_2O}$$

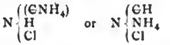
have been found identical so far as experiments at present went, but isomeric with ordinary amidobenzoic acid.—(*Zeitschr. Chem.*, N. F. iii. 564.)

Chlorhydrate of Cyanhydric Acid.—Arm. Gautier. Dry cyanhydric acid is saturated with chlorhydric acid gas at −10° C., and then heated in a closed vessel to 35°—40°. On again cooling the liquid solidifies to a white crystalline mass which is cyanhydric chlorhydrate $\mathrm{CNH + ClH}$. This compound decomposes very readily, is soluble in water, alcohol, and glacial acetic acid, insoluble in ether. Sulphuric acid expels chlorhydric acid with formation of sulphate. When heated with glacial acetic acid to 150° or 160° complete decomposition takes place, amongst the products of which formylamide and acetamide were found. When decomposing in presence of alcohol the chlorhydrate of a new base is formed together with ethylic chloride and formic ethide.



$$\mathrm{2N}\left\{\begin{matrix}\mathrm{CH}\\ \mathrm{H}\\ \mathrm{Cl}\end{matrix}\right. + 2\left.\begin{matrix}\mathrm{C_2H_5}\\ \mathrm{H}\end{matrix}\right\}\mathrm{O} = \mathrm{CH_5N_2Cl + C_2H_5Cl} +$$
$$+ \left.\begin{matrix}\mathrm{CHO}\\ \mathrm{C_2H_5}\end{matrix}\right\}\mathrm{O}$$

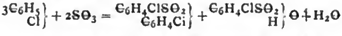
The base cannot be isolated with potassic hydrate, on account of its splitting up into ammonia and formic acid the moment it is set free. The chloroplatinate has the formula $\mathrm{2(CH_5N_2Cl)PtCl_4}$. This chlorhydrate is isomeric or perhaps identical with the compound obtained by the addition of chlorhydric acid to ammonic cyanide, and its constitution is represented by the formula—



$$\mathrm{N}\left\{\begin{matrix}\mathrm{(CNH_4)}\\ \mathrm{H}\\ \mathrm{Cl}\end{matrix}\right. \quad \text{or} \quad \mathrm{N}\left\{\begin{matrix}\mathrm{CH}\\ \mathrm{NH_4}\\ \mathrm{Cl}\end{matrix}\right.$$

preference being given to the latter.—*Comptes R.* lxv. 410 and 472).

Dichlorsulphobenzid.—R. Otto has not been able to confirm Gerike's statements as to the formation of dichlorsulphobenzid, by the action of chlorine or phosphoric chloride upon sulphobenzid, the products of this reaction being, according to the author, chlorbenzol and sulphobenzolic chloride. He, however, succeeded by acting upon monochlorbenzol with sulphuric anhydride at a low temperature. Dichlorsulphobenzid is formed according to the following equation:—



$$3\left.\begin{matrix}\mathrm{C_6H_5}\\ \mathrm{Cl}\end{matrix}\right\} + \mathrm{2SO_3} = \left.\begin{matrix}\mathrm{C_6H_4ClSO_2}\\ \mathrm{C_6H_4Cl}\end{matrix}\right\} + \left.\begin{matrix}\mathrm{C_6H_4ClSO_2}\\ \mathrm{H}\end{matrix}\right\}\mathrm{O} + \mathrm{H_2O}$$

This compound crystallises in white needles, fusing at 140—141° C., insoluble in water, readily soluble in hot alcohol or ether. It is not decomposed by an alcoholic solution of potassic hydrate. Sodium-amalgam reduces it principally to benzol and sulphobenzolic acid.—(*Zeitschr. Chem.* N.F. iii., 609.)

CORRESPONDENCE.

ELECTRICAL RESISTANCES.

To the Editor of the Chemical News.

Sir,—The following table of diameters and resistances of pure copper wires may not, perhaps, be unacceptable to electrical students and others.

The capacity of pure copper is taken at 100, and the unit of resistance used is the ohmad adopted by the Electrical Committee appointed by the British Association, one unit being equal to 1,760 yards, or 1609·31 metres of copper wire ·2302 inch diameter.

The value of the table consists mainly in its being a standard by which the student is enabled to ascertain the conducting power of any wire he may have under test, and also of its giving relative lengths of pound and kilogrammes, and proportionate diameters in decimals of inch and millimetres.

It is, perhaps, unnecessary to say that there is no better apparatus for obtaining tests than the electric balance manufactured by Mr. Becker, of Messrs. Elliott Brothers:—

Diameter of inch $\left(d = \sqrt{\frac{C}{l}}\right)$	Diameter of m.m. (= d × 25·4)	Number of yards per lb. $\left(l = \frac{C}{d^2}\right)$	Number of metres in 1 kilo. (= l × 2·016)	Resistance in ohms of pure copper (unit of length 1760 yds. or 1609·31 mtrs.)
·2302	5·847	2·095	4·223	1·00
·226	5·740	2·175	4·384	1·038
·198	5·029	2·834	5·713	1·352
·183	4·648	3·317	6·680	1·583
·175	4·445	3·628	7·314	1·731
·160	4·064	4·350	8·75	2·068
·136	3·454	6·007	12·11	2·867
·128	3·251	6·781	13·671	3·237
·107	2·717	9·705	19·555	4·623
·10	2·54	11·11	22·398	5·300
·092	2·336	13·125	26·46	6·266
·08	2·032	17·36	35·00	8·288
·07	1·778	22·67	45·71	10·82
·065	1·651	26·29	53·00	12·25
·0625	1·587	28·472	57·40	13·59
·06	1·521	30·864	62·223	14·73
·058	1·473	33·03	66·588	15·76
·056	1·422	35·432	71·431	16·91
·054	1·371	38·104	76·818	18·18
·052	1·32	41·091	82·839	19·61
·05	1·274	44·444	89·60	21·21
·048	1·219	48·225	97·222	23·02
·046	1·168	52·51	105·86	25·06
·044	1·117	57·39	115·70	27·39
·042	1·066	62·98	126·96	30·06
·04	1.016	69·444	140·00	33·14
·038	·965	77·16	155·50	36·72
·036	·914	85·766	172·91	40·92
·034	·864	95·29	292·70	45·48
·032	·813	108·5	218·74	51·79
·03	·762	123·46	248·90	58·93
·028	·711	141·72	285·71	67·65
·026	·660	164·36	331·35	78·46
·024	·609	192·9	380·26	92·08
·022	·558	229·56	462·80	109·58
·02	·508	277·78	560·01	132·59
·018	·457	342·94	691·36	163·69
·016	·406	434·03	875·00	207·17
·014	·355	569·51	1148·10	270·58
·012	·305	771·60	1555·50	368·30
·01	·254	1111·11	2239·80	530·35
·0095	·241	1231·10	2481·90	587·64
·009	·228	1371·7	2765·30	654·75
·0085	·216	1537·8	3100·20	734·05
·008	·203	1736·1	3500·00	828·67
·0075	.190	1975·3	3982·20	942·84
·007	·177	2267·6	4571·00	1082·4
·0065	·165	2629·9	5300·00	1225·3
·006	·152	3086·4	6222·30	1473·1
·0055	·139	3673·1	7404·90	1753·2
·005	·127	4444·4	8960·00	2121·4
·0045	·114	5487·0	11062·00	2619·0
·004	·106	6944·4	14000·00	3314·7
·0035	·088	9070·3	18285·00	4329·4
·003	·076	12346·0	24890·00	5892·7
·0025	·063	17777·0	35838·00	8485·6

The foregoing table is sufficiently comprehensive, embracing every size of wire likely to be used; but should the student have an intermediate size, he can obtain the diameter for himself as follows:—

d (diameter) = $\sqrt{\frac{C}{l}}$, l being the length in yards of lb., or $d = \sqrt{\frac{·111111}{28·472}} =$ ·0625, corresponding to one of the diameters in table. The value of C is 1-9th, or ·111111.

An easy method of obtaining the conducting power (P) of copper wire, assuming the experimentalist to have ascertained the accurate diameter by the above formula, is to test for resistance (r) by means of the balance above referred to, and the conducting power, $P = \frac{R}{r} \times 100$.

As a familiar example, one mile of ·0625 copper wire has, say, a resistance, r, = 16·5 ohms; the value of R in table = 13·59; hence $P = \frac{R}{r} \times 100 = \frac{13·59}{16·5} = 82·36$ per cent of pure copper.—I am, &c.,

Walter Hall.

Telegraph Works, Mansfield Street, Borough Road, S.E.

ARSENIOUS ACID.

To the Editor of the Chemical News.

Sir,—Seeing a notice in the Chemical News of last week, on the occurrence of prismatic arsenious acid, I beg to communicate a few observations made by myself in September last, on some peculiar crystals which I found in a flue from a calciner in which copper ores containing arsenic and sulphur are calcined.

The crystals were spear-shaped, not unlike marcasite in form; the lustre was pearly. They were deposited on small crystals (octohedral) of arsenious acid, and on taking them into the air I found that they began instantly to deliquesce.

They were readily soluble in a little hot water, with the exception of a trace of coal dust, mechanically mixed. On analysis, they were found to consist of—

Arsenious acid	75·10
Sulphuric acid	23·00
Sesquioxide of iron	1·25
Coal dust	trace

I imagine the iron to exist as a basic sulphate of sesquioxide.

Perhaps some of your readers will inform me whether such a compound as I have described has ever come under their notice. It is certainly quite new to me.—I am, &c.,

Richard Pearce.

Morfa Works, Swansea, March 17, 1863.

ON THE REACTION OF NITRITES WITH IODIDE OF POTASSIUM.

To the Editor of the Chemical News.

Sir,—In the last number of the Chemical News, Mr. Holland proposes to make use of the well-known reaction between nitrites, iodide of potassium, and sulphuric acid, to determine the amount of nitrous acid present in a water. The reaction referred to is certainly at first sight a most inviting one, and some time ago I made a few experiments to ascertain if a quantitative process could be procured from it; the results I then obtained convinced me that no accurate determination of nitrous acid could be founded upon it. The difficulty is that the reaction is a repeating one: that a minute amount of nitrite is capable (theoretically) of decomposing any quantity of hydriodic acid. I was led to this conclusion by the following experiments:—

To a weak solution of nitrite of sodium was added ten times as much iodide of potassium as there was nitrite present, and sulphuric acid exactly sufficient to decompose the iodide of potassium. After the addition of some starch paste, the iodine liberated was determined by a standard solution of hyposulphite of sodium. This determination of the iodine evolved, it was conceived, would afford the necessary datum for the estimation of the nitrous acid present. After decolourising the solution with the hyposulphite, the blue colour reappeared almost as strong as ever after a minute's standing. The solution was again decolourised, but the colour reappeared as before. I observed that the blue colour always commenced to show itself on the *surface* of the liquid, and thinking that the oxygen of the air was taking part in the reaction, I filled a test-tube to the brim with some of the decolourised liquid, and inserted a tightly fitting cork, thus excluding air from a portion of the solution. Thus circumstanced, the blue colour did not reappear, while in the remainder of the liquid in the open beaker it was soon as dark as ever.

What is then the nature of the reaction of nitrites with hydriodic acid? Fresenius tells us* that nitrites, acted on by an acid, split up into nitrates and nitric oxide.

$$3(NaNO_2) + H_2SO_4 = NaNO_3 + Na_2SO_4 + H_2O + 2(NO).$$

Nitric oxide is without effect on hydriodic acid, but on contact with air it is at once converted into hyponitric acid (NO_2), and this decomposes hydriodic acid, *nitric oxide being reproduced.*.

$$NO_2 + 2(HI) = NO + H_2O + I_2.$$

If, therefore, the nitric oxide were not slowly lost by diffusion into the atmosphere, a minute quantity of it would be sufficient to liberate an infinite amount of iodine. Here, I believe, is the reason of the extreme delicacy of the reaction: the minutest trace of nitrous acid in a water is sufficient, *in time*, to liberate a very distinct amount of iodine.

Mr. Holland says the solution is to be "allowed to stand until the colour is fully developed." Supposing the operator to wait till the greatest depth of colour is arrived at, the tint will depend (if an excess of hydriodic acid has been present) on the rate of diffusion of the nitric oxide into the atmosphere; this will be regulated by the temperature of the solution, the surface it exposes to the air, and by its state of concentration, as the gas will escape more rapidly from a strong solution than from a weak.

It appears then, I think, that the reaction in question does not afford the means for a satisfactory determination of nitrous acid.—I am, &c. R. Warington.

LECTURE EXPERIMENTS.

MELTING METAL IN A HANDKERCHIEF.

We are all familiar with the experiment of wrapping a handkerchief tightly round the bowl of a spoon, and holding the part of the handkerchief thus stretched over a spirit lamp, as an illustration of the conducting power of the metal of the spoon for heat. A more sensational form of the same experiment is to be found in such books as "The Young Man's Book of Amusement," "Endless Amusement," &c., in which a bullet is to be melted in a handkerchief by wrapping it round the bullet, and then holding the enclosed bullet over a candle until melted. On trying this experiment I have failed owing to the difficulty of preventing creases. The following modification of the experiment, however, is easily managed, and is very telling:—Two or three pounds of fusible alloy are melted, and run into an evaporating dish; when cold, a handkerchief is stretched over the smooth convex form thus obtained, and the mass may then be melted over a Bunsen's burner in the course of a few minutes; on piercing the handkerchief the melted metal runs out, and may be received in a mould.

C. J. Woodward, B.Sc.

Midland Institute, Birmingham, March 11th, 1868.

MISCELLANEOUS.

Spectral Analysis and the Bessemer Process.—The application of the spectroscope for conducting the charges in the Bessemer apparatus has become a practical reality. Professor Liellegg, of Gratz, of whose experimental researches with the spectroscope in the Bessemer steel works of the Southern Railway Company of Austria we have only recently given an account, has succeeded in pointing out a sufficiency of marked changes in the spectrum for enabling the managers of these steel works to watch and conduct the charges with the assistance of the spectroscope in preference to the routine previously adhered to at those works, a routine which, as a matter of course, was a strict copy of that existing in the Bessemer steel works of this country. By the aid of the spectroscope the manufacture of Bessemer steel, in the Gratz steel works, has been considerably improved with regard to that exact uniformity of hardness which formerly was more difficult to ensure under all circumstances. The great certainty with which the exact moment of complete decarburisation can be fixed by spectral analysis has reacted upon the amount of care now bestowed upon keeping the percentage of carbon in the spiegeleisen to a uniform or at least to a correctly ascertained amount, and regulating the quantity of spiegel employed by exact calculation. The accidental irregularities and differences of hardness between the different charges have thereby been lessened to a very considerable extent, and an increased reliability has by these means been given to the Bessemer process. Some other Austrian Bessemer steel works, and the Government works of Neuberg amongst these, have sent engineers to Gratz in order that they may subject and introduce it into their own respective establishments, and an account of Professor Liellegg's discoveries has been published in the *Austrian Gazette for Mining and Metallurgy*. The spectrum pointed out by Professor Liellegg, belongs to the flame of carbonic oxide. It can be seen in the flame escaping from the mouth of the converter during the preliminary operation of heating this vessel with coke only; and in that case the lines referred to are very faint, and it requires some practice or knowledge of the precise spots in the spectrum where these bright lines should be looked for, to discover them. During the first period of the Bessemer process the spectrum is very faint. The yellow portion is almost invisible, and even the sodium line is missing; the blue and purple portions are extremely faint. The absence of the sodium line can be accounted for only by the consideration that there is no real flame formed by incandescent gases escaping from the converter at that early stage, but only a mass of sparks carried by the nitrogen from the blast, the oxygen of which remains in the converter, combining with silicium. As the flame gradually appears in the centre of the volley of sparks, the spectrum widens and shows yellow light, until suddenly, the sodium line in the yellow field becomes visible, first only for moments as a flashing bright streak, and after less than one minute as a constant and clearly defined line. The appearance of the sodium line marks the commencement of the decarburisation, although this line does not belong to the charge of iron at all, but rather to the accidental presence of sodium compounds in very minute quantities. It is therefore only indirectly connected with the combustion of carbon; *i. e.*, the appearance of the sodium line is a signal of the completion of the continuous spectrum, and this continuous spectrum belongs to the combustion of carbon. As soon as the sodium line has taken a steady and permanent appearance, the characteristic lines of the carbonic oxide may be looked for in the greenish-yellow, in the green, and in the purple field. In each of these three fields one bright line becomes clearly visible at that time. As the flame increases in size and brilliancy, the spectrum comes out more and more clearly. Bright lines increase in number in each of the first-named three fields, and ultimately, at the height of the process, some bright lines show themselves in the red and, occasionally, also in the blue field. The green field of the spectrum, however, is the real point of observation in practice, as in this the lines are most clearly visible, and in it they appear first and disappear last. The spectrum, as a whole, is by no means steady or constant, but its fluctuations do not displace any of the bright lines; they only alter the back ground for the continuous spectrum upon which they appear. After the "boil," the maximum intensity is reached; and at that stage, and only with very hot charges, a bundle of bright lines appear in the bluish-purple portion of the spectrum. About four or five minutes before the end of the charge of three tons, the lines begin to disappear in rapid succession, and in the invented order of their appearance—first, the bluish-purple, then the blue lines, after these the red, &c. When the last green line disappears, the vessel is turned, and the charge completed by the addition of spiegeleisen. The yellow sodium line does not disappear to the end of the operation. Sometimes the vessel is turned when all lines in the green field with the exception of two have disappeared. This depends upon the special experience of the case, and it is clear that it is of less importance whether the one or the other mark be taken, if it is only regularly adhered to, and the charge of spiegeleisen regulated accordingly. The practical results are highly satisfactory, since they make the regularity of the "temper" of Bessemer steel practically independent of the skill and experience of the charge-manager, the changes of the spectrum being made more marked and unmistakable than those of the appearance of the flame itself. Hitherto, no experience with British hæmatite irons has been gained, and the use of the spectroscope in this country must be preceded by some careful trials and observations in order to fix the character of the changes. It is highly probable that they will prove very similar, if not absolutely the same as those observed with Styrian charcoal iron, but mere probabilities are not sufficient in the case like this. If the Bessemer steel makers should gain no more by the use of the spectroscope than the possibility to show to the noisy disbelievers in the uniformity of Bessemer steel that a child may conduct the charge without the least chance of error, just the same as a boy can now work the whole mechanical apparatus of the converters, the gain would be very great. But there is a greater gain immediately to be realised by the use of the spectroscope. The steel-masters will become less dependent upon the skill and attention of their charge-managers or foremen, and the percentage of waste or unsuitable material produced by carelessness or mistakes will be lessened in the general run of practice. —*Engineering*.

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* "Qualitative Analysis," sixth edition, p. 82.

NOTES AND QUERIES.

Treating Mineral Oils.—Can any of your correspondents give me a process for treating heavy mineral oils so as to free them from smell, and make them of a bright colour on a manufacturing scale.—A. O. R.

Sugar Refining.—Will you kindly inform me in your "Answers to Correspondents" what becomes of the acetic acid which is set free by the sulphurous acid in "Scoffern's Process" for the refining of sugar? As nearly all the acetates are soluble, and free acid in contact with the dissolved sugar would convert some of the cane sugar into grape sugar."—J. Davies, Bath.

Sulphite and Hyposulphite of Soda.—In reply to "G. W. R., Liverpool," I beg to say that there is a large demand for hypotulphite of soda by paper makers as so-called *antichlore*; about 200 sons per annum are yearly consumed in photographic operations alone, while a far larger amount is used by paper makers: hyposulphite of soda is also used by bleachers of calico fabrics. Sulphite of soda is of a more limited use, and somewhat superseded by the hyposulphite. —Dr. A. A.

Signs of Rain.—Of the many prophets that appear in the present day, certainly the weather-eyed ones predominate. Of their prophecies, I may dub myself sceptical, as nearly 99·999 per cent of the human world do; for the simple reason that their statements are always the reverse of facts. But there is a sign of rain that is known as true to every observing observer, without the study of the stars, or anything else. I allude to a red sunrise, which invariably denotes rain within a few hours. I wish to ask if any reader of the Chemical News can explain why the sun should rise apparently so red when the atmosphere is in, I suppose, a dense state previous to rain. I remember reading a very interesting paper or lecture in the Chemical News, giving the reason for red sunsets. I read the papers at the time with great relish; but I have been subsequently occupied with other matters, incompatible with the retention of theoretic knowledge, and I have not my volumes of the News at hand to refresh my memory. However, I think my memory is correct enough to be able to assert that the facts, as represented in the papers referred to, do not give any reasons for this atmospheric phenomenon, or any basis for establishing a theory of its cause.—An Observer of Nature.

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

48. C. D. Abel, Southampton Buildings, Chancery Lane, "An improved method or process for removing sulpher, phosphorus, and other impurities from iron, steel, and other metals."—A communication from J. F. Bennett, Pittsburgh, Penn, U.S.A.

59. G. Davies, Serle Street, Lincoln's Inn, Middlesex, "Improvements in the mode of combining wrought and cast iron or other metals for various useful purposes."—A communication from W. M. Arnold, New York, U.S.A.

64. P. Spence, Newton Heath, Manchester, "Improvements applicable to roasting or calcining copper and other ores containing sulphur and also regulus, and in apparatus connected therewith."—January 7, 1868.

78. W. E. Kenworthy, Crown Point Road, Leeds, "An improved method of purifying drains and sewers."—January 8, 1868.

85. C. J. B. King, Great Portland Street, Middlesex, "An improved process to be employed in the tanning of skins or hides."

86. C. H. Newman, Brentford End, Middlesex, "Improvements in the manufacture of unfermented and unintoxicating malt liquors."—January 9, 1868.

95. J. Fawcett, Kirton in Lindsay, Lincolnshire, "An improved manufacture of cattle food."

96. J. M. Rowan, Glasgow, N.B., "Improvements in the manufacture of artificial fuel."—A communication from J. R. V. S. Traunfels, Vienna.—January 10, 1868.

105. J. Somervell, Kendal, Westmoreland, "An improved method of obtaining and preserving alimentary substances in a highly-concentrated form."

112. T. Whitwell, Stockton-on-Tees, Durham, "Improvements in furnaces."—January 11, 1868.

131. G. Nimmo, Jersey, New Jersey, U.S.A., "An improved composition for furnace linings, fire bricks, pots, crucibles, and other articles.

138. J. Kidd, St. Paul's Wharf, London, "Improvements in obtaining artificial light, and in apparatus employed therein."

139. J. Head, Newport Mills, near Middlesborough, Yorkshire, "Improvements in furnaces for puddling, boiling, melting, or heating iron or steel."—January 15, 1868.

149. J. A. Jones, Middlesborough, Yorkshire, "Improvements in the manufacture of iron and steel."—January 16, 1868.

164. H. Aitken, Falkirk, Stirling, N.B., "Improvements in treating iron ores or iron stones for the purpose of effecting economy in the obtainment of iron and other products therefrom."—January 17, 1868.

MEETINGS FOR THE WEEK.

Monday.—Geographical, 8.
Tuesday.—Royal Institution, 3. Dr. M. Foster, "On the Developement of Animals."
Wednesday.—Society of Arts, 8.
— Geogloical, 8. 1. "On some New Forms of Palæozoic Corals," by Henry Woodward, Esq., F.Z.S., F.G.S. 2. "On the Coniston Group," by Professor Harkness, F.G.S., and H. A. Nicholson, Esq., F.G.S. 3. Death of Fishes on the Coast of the Bay of Fundy," by Dr. A. Leith Adams, F.G.S.
Thursday.—Royal Institution, 3. Dr. M. Foster, "On the Developement of Animals."
— Royal, 8½.
— Zoological, 8½.
— Philosophical Club, 6.
Friday.—Royal Institution, 8. Dr. Carpenter, "On the Unconscious Action of the Brain."
Saturday.—Royal Institution, 3. Professor Roscoe, "On the Non-Metallic Elements."

TO CORRESPONDENTS.

Drs. Wischin and Wilm's telegram from Berlin, asking us not to publish their letter "On the Reduction of Carbonic Acid to Oxalic Acid," arrived on Monday morning—three days too late.

⁂ Owing to pressure on our space, the further "Answers to Correspondents" will be given in our next.

THE CHEMICAL NEWS.

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ON THE
NATURE AND EXAMINATION OF THE ORGANIC MATTER IN POTABLE WATERS.*

By CHARLES R. C. TICHBORNE, F.C.S., Dublin.

The importance of my subject must be my excuse for bringing before you this rather heterogeneous mass of remarks and notes upon the subject of the Organic Matter in Water. During the cholera visitation of last year, I made some observations in connection with water-analyses, the cream of which experience is embodied in my paper.

It must be palpable to every one, that no individual point in the analyses of waters can give much information as regards their fitness or unfitness for drinking purposes. But it is also quite as evident that the danger (where there is any) lies buried in what the chemists term the organic matter; and that there are times when that organic matter is in a more than usual dangerous state. The point of difficulty in the examination of potable waters, is not so much its quantitative determination as its qualitative. You may have a water rich in organic matter, yet harmless; or a water containing but a minimum of organic matter, but organic matter of such a deleterious nature, that our ideas of the most virulent substance fall short of the horrible results that these invisible poisons can accomplish. Weight for weight, or bulk for bulk, how far behind in virulence are such poisons as hydrocyanic acid, strychnine, or the secretion of the dreaded cobra fangs.

I may say, our opinion upon the state of a water, or rather the state of the organic matter therein (presuming it contains any), is, so far as the chemists have gone, only to be arrived at by the putting together of many examinations. For all the following points bear upon the state of the organic matter, or its qualitative examination.

Total Estimation of the Organic Matter.—If this be present in abnormal quantities, that cannot be explained by its origin, such water should be at once condemned.

Ammonia.—This again depends upon the source from which the water was obtained. We possess a very good test for ammonia. Messrs. Wanklyn and Smith have pointed out some important facts connected with the examination of water; that, on distilling water that contains urea (a probable ingredient in sewage-water), it is converted into ammonia. Thus, an approximate estimation of the nitrogenous substance resembling urea may be made, after making an allowance for the ammonia occurring as such. The experiments of Messrs. Wanklyn and Smith in connection with the nitrogenous matter are well worthy our careful consideration, although we do not agree with them entirely.

A ready and quick mode of estimating the organic matter in solution has yet to be discovered—the estimation by a volumetric solution of permanganate of potassium being worthless.

The *microscopic examination* of any sediment, if there be any present, is of the utmost importance, as often an accidental and recognisable impurity will afford evidence of the inroad of sewage.

Taste, odour, hardness, chlorides, total saline ingredients, sulphuretted hydrogen, relative proportions of the gases dissolved in the water, are all points connected with the state of the organic matters, but call for no particular remarks upon my part.

Another very important point in connection with water intended for drinking purposes, is the colour. Every kind of water, whether from a spring, river, or reservoir, possesses a certain tinge, however faint that tinge may be. An instrument, which I will call the chromiometer, is particularly suited to this purpose. In a paper, which I wrote some years ago, "On the Urinary Pigment" (Chemical News, March, 1862), I described this instrument, and suggested its use for the determination of the relative amount of pigment voided. A similar instrument is now used by Dr. Letheby for the examination of water. I shall describe my own arrangement of this instrument. To observe the colour, a pencil of light passing through a considerable body of the water is viewed by means of a tube. The apparatus consists of this tube, a yard in length, well closed at one end by a stopper. The stopper is preferable to a permanently fixed end, as it enables the operator to clean the tube perfectly—a matter of some importance. On the bottom is fixed a piece of white porcelain—a sight, if I may use the term. The tube is graduated into convenient divisions for the relative examination of different samples. By filling the tube with the water to be examined, and looking through the water at the white disc at the bottom, a faint colouration is at once perceived. Thus an experienced eye will, after a chromatic examination, prognosticate the character of his microscopic examination. The green chlorophyll tinge is almost invariably produced by the presence of desmidiaceæ and other algæ, or similar bodies. A white opacity is frequently indicative of fungoid growths. The finely suspended basic persalts of iron frequently found in waters rich in organic matter, which pass through iron-pipes, etc., are instantly recognised by a peculiar ochrey colour. True chalybeate springs also deposit a similar precipitate when exposed to atmospheric oxygen. Another important application of this tube is the determination of the state of oxidation of the iron-salts in the water, if present. This is a matter of some importance, particularly in connection with the organic matter; and I shall perhaps be excused if I dwell a little upon this point.

Iron is almost always present in well-waters, and frequently so in river or reservoir water. If present in very minute quantities, the primitive state of oxidation can only be recognised with the aid of the chromiometer.

As the microscope magnifies the form, so does the chromiometer magnify the colour so as to be recognisable by the eye. We are enabled to extend the range of our ordinary chromatic tests, and to recognise minute quantities of the proto- and per-salts of iron. Any attempt to concentrate the water for examination would alter the state of oxidation, and the results would be fallacious. Thus, on adding to separate portions of the water in the tube a few drops of the ordinary reagents, the following results are obtained. Sulphocyanide of ammonium developes a pink tinge, indicative of the persalts of iron. A few drops of nitric acid are added to another specimen, and tested with sulphocyanide of ammonium. A darker shade is produced than in the first experiment. This is indicative of the presence both of per- and proto-salts of iron. Colouration, only produced after the addition of nitric acid and sulphocyanide, indicates that the iron is present as a proto-salt. When the iron bears a considerable proportion to the organic matter in the water, little or no organic matter, if we except ammonia, will be found in solution, providing the iron is in the state of a per-salt. If, however, the iron be present as a proto-salt, it will exert very little influence on the organic matter, and frequently such waters (except deep chalybeate springs) will be found to contain large quantities of soluble organic matter. Thus it is, that a water containing proto-salts of iron and organic matter will frequently, although quite clear on drawing from the well, become cloudy and deposit a mass of red flakes. They consist of a basic salt of iron, which retains the whole, or nearly the whole, of the organic matter. The trace left in solution is of an unfermentable nature.

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* Read in the Physiological Section, before the Annual Meeting of the British Medical Association in Dublin, August, 1867.

The estimation of nitrites is one of importance. It is easily and readily performed in the following manner. I am induced to insert it here, as it differs from all the methods in use. It might at first sight appear strange that I should advocate the use of a volumetric solution of permanganate of potassium, when, in another part of my paper, I heartily condemn that reagent; but it will be also seen that there are two exceptions to the uncertainty of the action of permanganate of potassium; viz., oxalic acid and the nitrites. There are many operations in vogue for estimating nitrates; two of which the author proposed some years ago. ("On the Estimation of Nitrites in the presence of Nitrates," *Proceedings of the Pharmaceutical Conference*, Birmingham, 1865.) All of these methods require more or less care, combined with a considerable amount of manipulation. The following process is particularly applicable to potable waters as the nitrites therein are in a very diluted state. The method is based upon the reaction that nitrite of ammonium is on heating split up into nitrogen gas and water ($NO_2NH_4 = 2N + 2H_2O$). Eight ounces of the water to be examined are boiled, and, after cooling, are made up to the original bulk with pure water. The readily oxidisable matter in this measured portion is then estimated with volumetric solution of permanganate of potassium according to the directions given by Dr. Miller ("Observations on some Points in the Analysis of Potable Waters," by Professor Miller—*Journal of the Chemical Society*, vol. 3, new series, p. 119), *i.e.*, the volumetric solution is added a few degrees at a time, at short intervals, until a permanent pink tinge remains. We will suppose that the sample of water under examination used up 30° of the permanganate solution. The thirty degrees were consumed in the oxidation of all the nitrites, *plus* some of the more readily oxidisable products. To a separate eight ounces of the water is added a few drops of a solution of pure sulphate of ammonium, and the whole is evaporated to dryness at a temperature below 100° C. The residue is again dissolved in 8 oz. of pure water, and estimated under exactly similar circumstances with the volumetric solution of permanganate of potassium. I will suppose that only 10° are now decomposed. These 10° represent readily oxidisable matter—the difference in the two estimations—*i.e.*, the 20° represent the nitrous acid present, which has been entirely destroyed and dissipated as nitrogen and water.

It must be self-evident to chemists, that to look for a specific test for miasma in water is absurd; that there are certain subtle substances of intense power which are physically unrecognisable—substances that, so far as we have gone, no balance can weigh, no microscope can see. Some time ago, there appeared an elaborate paper from M. Stas. M. Stas has made a great name for himself; he is deservedly looked upon as one of our best chemists, and he has made his name by the exquisite care with which he conducts his experiments. He found out what most chemists have found out—how very difficult it is to get pure water. Simple distillation will not do it. He therefore proposed to digest the water upon manganate of potassium—to destroy the organic matter. But I have here a water which has been treated as he directs; and I have even gone further with these experiments, for one of these specimens is now standing upon manganic acid itself—the most powerful oxidiser we have. One is water which had originally been distilled from a few grains of musk, and the other from fusel oil. It will be seen from the odours that one of these substances has escaped the oxidation entirely, and that the other has merely absorbed oxygen to be converted into another substance even more disagreeable than that originally contained therein, namely, valerianic acid. The late researches upon limited oxidation by Messrs. Wanklyn and Chapman show that the results of the action of oxidisers upon organic matter in solution are complicated, and entirely differ in their character from a perfect combustion. Therefore M. Stas's assumption, that nothing is present in water distilled from manganate of potassium, must be fallacious. This naturally brings me to the consideration of the utility of permanganate of potassium, which has been fashionable until lately for determining the amount of organic matter in water. It has been the opinion of most practical chemists who have had much experience with water, that that test was worthless as a measure of organic matter. A chemical friend of mine remarked to me, "It is the colour that does it. If it were not for its beautiful colour and the prettiness of the reaction, no one would use it." And I really think there is something in the remark.

Dr. Frankland was, I believe, the first to enter his protest (in type) against the use of this reagent as a measure of organic matter "Lectures on Water" (Royal Institution, 1867); although, as far back as 1866, I, in the presence of Dr. Mapother, practically illustrated its worthlessness at a public meeting in this city, when the experiments were entered upon the minutes of the meeting. I merely mention this fact in case the experiments which I give below might be considered as a babbling echo of what has, perhaps, been so much better put to the public; but I insert them here from two reasons. The first of these is, that many of the substances upon which I have experimented, although they are not given by Dr. Frankland, are yet typical of the organic matter likely to be met with in potable waters; secondly, that some curious points are illustrated by my experiments, which would not be foreseen by the scientific man.

A large number of experiments were instituted under exactly similar circumstances, for the purpose of observing what class of organic substances were readily oxidised, and how far their state of combination might affect the change. To effect this, the process recommended by Dr. Miller was fixed upon as the most suitable for watching the relative action. A volumetric solution of permanganate of potassium was used, which corresponded to ·22 oxalic acid. The different solutions were made by dissolving in each case ·2 of a *gramme* of the organic matter in (568 c.c.) an imperial pint of pure water. A degree of the permanganate solution was added at intervals of a quarter of an hour as long as any decolouration took place, half an hour being the crucial test allowed. The temperature was in each case 60° Fahr., or as near as it was possible to conduct the experiments. The quantity operated upon was eight ounces. Sulphuric acid was used in every case for acidulating the solutions; soda for rendering them alkaline. From above one hundred experiments, the following are selected as typical.

No.	Substance.	In an acidulated solution.	Rendered faintly alkaline.
1	Oxalic acid	36° (reaction very marked and decided)	No reaction.
2	Nitrite of potassium	(Reaction well marked and decided)	No reaction.
3	Nitrate of ammonium	No reaction	No reaction.
4	Chloride of ammonium	No reaction	No reaction.
5	Ammonia	No reaction	No reaction.
6	Trimethylamine	35°	(action
7	Nicotine	2°	Very decided re-
8	Conium	4·5°	
9	Aniline	314°	
10	Urea	No reaction	No reaction.
11	Uric acid	26°	52°
12	Urinary pigment	4·5°	4·5°
13	Hydrocyanic acid	4·5°	54°
14	Strychnine	35° (not finished, as the action could not be followed).	More decided
15	Sugar	1°	1°
16	Albumen (partially decomposed)	38°	1°
17	Albumen (coagulated)	38°	
18	Oxalic and urea	15°	
19	Lactate of lime = *gramme* ·2 Lactic acid	No reaction	
20	Butyrate of lime = *gramme* ·2 Butyric acid	No reaction	2°

In most cases, the products are more easily oxidised accordingly as their chemical affinities are disengaged or not. This is illustrated in Experiment 7 (nicotine), where its marked basic properties affect materially the oxidising influence. Urea, sugar, &c., which we should naturally expect to be so easily decomposed, have no action under these circumstances with permanganate of potassium. The action with hydrocyanic acid is curious; but it is probable that the number of degrees required in an alkaline solution is merely due to the conversion of a cyanide into a cyanate. Experiment 18 was tried to find if the decomposition or the decomposing influence of one substance might be transferred from one substance to the other; but, with a few exceptions, this was not found to be the case. The degrees required were simply what would be consumed by each ingredient. It must be borne in mind that temperature influences the activity of the permanganate of potassium; that many substances that are not acted upon in the above experiments are dedecomposed at a more elevated temperature. These experiments are, in my opinion, useful, from the fact that they probably enable us to watch changes similar to those that are carried on from atmospheric oxidation. Changes which are too slow and gradual to permit of a practical examination may, perhaps, be fathomed by such experiments as those detailed. They are, therefore, worthy of a further extension. It was found that waters containing different organic substances, when allowed to decompose, do not give rise to the same microscopic phases of life; but certain substances seem conducive to certain species. It would, however, extend this paper too much to enter into the microscopic examinations.

I am of opinion that peroxide of hydrogen is a substance which ultimately may be used with advantage for the purification of drinking water. It may be viewed as water supersaturated with oxygen, the extra equivalent of oxygen being held by the faintest phase of attachment coming within the term of chemical attraction; so that the least disturbing agency imaginable would decompose it into oxygen, ozone, and water. Peroxide of hydrogen oxidises organic matter, and stops fermentation: therefore, providing that we had a pure article, we could oxidise the organic matter, without introducing anything but pure water. But at present peroxide of hydrogen is very dear, and, as found in commerce, is much too impure to be used in drinking water. Another doubtful point is, that this curious substance sometimes seems to play the part of a reducing agent, as well as an oxidiser. If so, sulphuretted hydrogen might be generated by its action upon sulpho-compounds, such as albumen.

It has been lately stated that charcoal will not, after a little time, purify drinking water; and that, so far from taking from the water organic matter, it gives up again a certain amount. Thus: that water, on analysis before and after passing through charcoal which had been some time in use, was more contaminated with organic matter after having been passed through the said filtering medium. If it were not for the fact that the paper containing the above statement had received a considerable amount of commendation, and, *ergo*, publicity, I should have passed it by. But the author of that paper evidently misunderstood the position. The *modus operandi* by which charcoal acts on oxidisable organic substances is not so much by virtue of any attractive or selective power that it possesses; but, as a carrier of oxygen in a concentrated form, it is one of the most powerful oxidisers we possess. The oxygen condensed within the charcoal acting more energetically than the available oxygen, we can apply in the form of permanganate of potassium. The original experiments of Dr. Stenhouse in connection with the action of charcoal have received ample confirmation from the late investigation of Professor Calvert (*Journal of the Chemical Society*, June, 1867).

It is true that charcoal, after a certain time, becomes effete—its activity destroyed; but it is equally wonderful to observe the length of time a charcoal-filter with the following provisions will retain its vitality, if I may use the expression. 1. That the water passed through it does not contain a very large percentage of organic matter; 2. That it is drained from the water the better part of each day, so that the atmospheric oxygen (with as little of the dust as possible) may have access to it. Charcoal, under these circumstances, will be found to do its work well. You must give it its food quietly, so that it can digest it.

I can hardly believe the statement made, that charcoal will, after a certain period, transfer again organic matter to water. I have examined water before and after passing through a charcoal filter which had been in daily use in my own house over a month. There was not much difference, it is true; but the water which had passed through the filter had most decidedly the advantage. I can well imagine that, as the charcoal acts as a mechanical recipient to the insoluble organic matter, that substance may at last accumulate to such an extent as to enter itself into a state of fermentative change. The activity of the charcoal, being by this time exhausted, or at least only sufficient to supply a minimum of oxygen, would only assist such a decomposition. This state of the case would be simply the putrefaction of a mass of solid organic matter independent of the charcoal—not the rendering back from the charcoal of something it had absorbed from the water. I would suggest that a well-constructed water-filter should have an arrangement by which the insoluble organic matter should be separated before the water comes into contact with the filter. In such a filter, the organic matter could never accumulate.

In conclusion, I may point out that the most valuable method of examining water is that which I believe was first used by Dr. Frankland—that is to say, to examine the relative amount of oxygen and nitrogen found in water. In absorbing atmospheric air, the oxygen is dissolved with a little greater avidity, so that that gas is found in water in a larger relative proportion than in atmospheric air; viz., the relative proportion of oxygen to nitrogen is about 21 to 79; but as found in water it is about 32 to 68. Now, if the enclosed air is found to contain less oxygen, it shows that that element is being consumed by chemical changes going on within the water; or, in other words, such a water is not in its normal state, and therefore is unfit for general use.

The aqueducts of antiquity show how important the blessings of pure water were considered from time immemorial, and how necessary to the welfare of all communities. But I cannot see that we have improved upon our forefathers; for, whilst they spent enormous sums to produce stupendous supplies, we seem to me to spend our money in merely building immense reservoirs. Anything is, however, better than that "like a dog we should return to our own vomit."

> "Most blessed water, neither tongue can tell
> The blessedness thereof; no heart can think,
> Save only those to whom it has been given,
> To taste of that divinest gift of heaven."

An Alleged Preservative against the Cattle Plague.—Chloride of copper is now extensively used in Germany against the cattle plague, or rather as a preservative. The *modus operandi* is as follows:—Take green crystallised chloride of copper, 8 grm.; spirits of wine, 2 kilog., and dissolve. With this solution impregnate a pad of cotton, lay it on a plate, and set fire to it in the centre of the stable, turning the animals' heads towards the flame, so as to make them breathe the fumes. This operation is performed morning and evening, burning one pad for every three heads of cattle. At night, a spirit-lamp, filled with the solution, is lighted in the stable. To prevent accidents, the flame is surrounded with wire-gauze. The liquid is also administered internally, with the addition of 15 grm. of chloroform for the above quantity. A tea-spoonful of this is put into the animal's drink three times a day. As a further precaution the litters are watered with the same solution.

ON THE FORMATION OF
A SERIES OF DOUBLE SULPHOCYANIDES OF CERTAIN OF THE ALKALOIDS
WITH THE METALS
ZINC, TIN, MERCURY, AND MOLYBDENUM.

By WILLIAM SKEY,
Analyst to the Geological Survey of New Zealand.

While engaged in testing some of the chemical properties of the alkaloids, in relation to those of the inorganic bases, a new set of reactions have just discovered themselves, which I will briefly note preparatory to a further communication thereon. These reactions consist in the formation of precipitates, when an acid solution of certain of the alkaloids is brought in contact with a solution of a salt of zinc, tin, mercury, or molybdenum, in presence of hydro-sulphocyanic acid.

To avoid the formation of single sulphocyanides, it is best to employ solutions of the metals and alkaloids of such strength that a sulphocyanide makes no precipitate in either solution separately.

The precipitate formed by nicotina, mercury, and sulphocyanogen, in presence of each other, by quina, sulphocyanogen, and zinc, or mercury, and by strychnia, zinc, and sulphocyanogen, was found to yield these several substances respectively; the remaining precipitates I have not yet had time to examine, but pending this and the quantitative analysis of some, I will for the present suppose all these precipitates to be compound sulphocyanides.

Generally these compound sulphocyanides are very insoluble in cold water, more soluble in hot water, and freely soluble in alcohol; they are but little affected by hydrochloric or sulphuric acids,—but are decomposed by alkalies,—while their physical properties are in some instances very characteristic.

The following are details respecting the more interesting of them:—

Sulphocyanide of Strychnia and Zinc separates as a gelatinous mass, but gradually assumes the form of long acicular crystals. Sulphocyanide of strychnia and mercury is crystalline (it is soluble in sulphocyanide of potassium).

Sulphocyanide of Quina and Zinc is solid and brittle at 70°, soft and plastic at 90°, and changing to a fluid, or semi-fluid substance at about 200°, which appears to crystallise on cooling.

Sulphocyanide of Nicotina and Zinc is crystalline, while the tin, mercury, and molybdenum salts are oils at common temperatures; they are nearly colourless, with the exception of that of molybdenum, which is of a rich purplish red colour.

The Sulphocyanide of Atropia and Tin is a semi-solid fat at 60°, while the zinc, mercury, and molybdena salts are oils; the last is of a dark red colour.

Sulphocyanide of Morphia and Zinc or Tin was obtained in amorphous forms; they fuse at a very slight elevation of temperature; the mercury compound is an oil.

Sulphocyanide of Narcotine and Mercury is crystalline, and easily fusible.

Sulphocyanide of Veratria and Zinc, Tin, Mercury, and Molybdenum resemble the sulphocyanide of veratria in the gelatinous appearance they assume.

Sulphocyanide of Conia and Mercury is a green crystalline substance.

The remaining natural alkaloids have not yet been tested, but sufficient is shown to make it probable that this property of forming double sulphocyanides with certain of the metals, is possessed by all.

With regard to the metals thus connected together by these reactions, I would observe, the only character common, and at the same time, to some extent, peculiar to all, is that of the ready fusibility and volatility of their chlorides. I may state that aniline does not give any precipitate when substituted for the alkaloids.

The feebly basic nitrogenous substances, gelatine and isinglass, behave like veratria.

For the detection, separation, and determination of certain of these alkaloids, it is possible these reactions may be advantageously employed.

ON THE USE OF METHYLATED SPIRIT IN PHARMACY.

The following paper is a condensed translation of a report made to the Medical Council of the province of North Holland, by six of its members, among whom was Prof. Dr. J. Gunning. In accordance with the excellent laws which, since January, 1866, regulate in the Netherlands all matters relating to medicine in its more extended sense, there is in every province [county] of the kingdom a medical council composed of medical men, pharmaceutists, and lawyers. As regards the free use of methylated spirit by pharmaceutists, the committee just alluded to is of opinion that it would be manifestly unfair to pharmaceutical chemists who are in the habit of preparing, or manufacturing, for instance, such substances as quinine and other alkaloids, to require that such articles should, as far as such is required, be made by them with alcohol, whereas the wholesale maker would use, and quite justly so, methylated spirit. The committee, however, distinctly desire it to be understood that the use of methylated spirit cannot be allowed in the preparation of medicinal tinctures, for although it is true that the methyl-alcohol, as it is met with in ordinary wood-spirit, bears the greatest analogy to ethyl-alcohol, there occur beside in wood-spirit, acetate of methyl and aceton, both of which, in their solvent power, more resemble ether, and, consequently, influence and alter the real constituents of tinctures to be prepared with alcohol; the same, of course, applies to alcoholic extracts. The committee also disapproves of the manufacture of ether and chloroform for medicinal use from methylated spirit. Since the inspection of chemists' shops in the Netherlands, and the testing of the divers pharmaceutical preparations is a duty of the Medical Council's, it was necessary to find ready tests to ascertain whether or not methylated spirits have been unlawfully applied. The following are the results of some experiments instituted on purpose by the members of the above-named Committee. It is quite possible to recognise even in tinctures which contain strongly-scented substances, the wood-spirit, if methylated spirit was used in the preparation thereof; the smell is even detected three months after the tinctures have been made, but if a doubt arises, it is best to mix the tincture in question with double its bulk of boiling water. Tinctures containing free ammonia beside must be first rendered neutral. Another test is the following:—The alcoholic fluid in question is mixed with twice its bulk of strong ammonia.

Next there is added, while the fluid under examination is well stirred up, a few drops of a solution of 10 grs. of iodine and 20 grs. of iodide of potassium, in half a fluid ounce of distilled water. In case the fluid under examination does *not* contain methylated spirit, there will soon be observed a finely-divided precipitate of a black substance (iodine ?), giving to the fluid a dark bluish appearance; if, on the other hand wood spirit or methylated spirit is present, the fluid remains clear, assumes a brownish yellow, but rapidly again vanishing hue; after the fluid has become quite colourless again, there will distinctly be perceived, on smelling it, an odour of saffron, while shortly after, also very frequently, crystals of iodoform are deposited. This test and reaction are discovered by Mr. J. Polak. Tincture of iodine made with methylated spirit may be detected, since on addition of liquid ammonia it becomes readily and without application of heat, discoloured, the saffronaceous odour will be smelt, and crystals of iodoform deposited. The above-named test is not disturbed by the presence of essential oils, camphor, compound ethers, &c. It is best, however, that, as regards the application of this test to tinctures, the latter should be submitted to distillation, and the distillate tried by the reagent. From a series of interesting experiments instituted by the committee, in order to test in how far methylated spirits might change the constitution of alcoholic extracts made with methylated spirit instead of with pure alcohol, it appears that methylated spirit dissolves out from 2 to 7 per cent more from vegetables than alcohol does, while in the case of extracts of cicuta and belladonna the amount was from 13 to 14 per cent more if methylated spirit instead of pure alcohol was applied. The following are the results of experiments instituted with ether, æther muriaticus alcoholicus, æther aceticus, æther nitricus, alcoholicus, and chloroform made with pure alcohol and methylated spirit.

Ether from methylated spirit cannot be detected by the smell, but easily by the following test:—Pour carefully some strong sulphuric acid in a test tube, hold it then as slantingly as possible, and then pour in as carefully as possible some of the ether; if the latter is obtained from methylated spirit, it will be seen that at the place of contact of the two fluids, a dark brownish yellow colouration ensues, which, if the ether were obtained from pure alcohol, and submitted to a similar experiment, will be found absent, or at least hardly perceptible. Æther muriaticus, alcoholicus, and æther nitricus alcoholicus can at once be detected by the iodine test spoken of before if they have been prepared with methylated spirit.

Æther aceticus, prepared either with pure alcohol or with methylated spirit, is not recognised by the smell, but the iodine test detects the origin from methylated spirit at once, and it hence follows that acetic ether obtained from methylated spirit contains acetate of methyl and also aceton.

Chloroform, if prepared with methylated spirit, may be recognised by the smell, which is different from that of chloroform obtained from pure alcohol; beside this, the discolouration with sulphuric acid takes place with chloroform as with ether made from methylated spirit.

ON A

NEW GENERAL METHOD OF VOLUMETRIC ANALYSIS.

By WOLCOTT GIBBS, M.D.,
Rumford Professor in Harvard University.

In a memoir on the quantitative determination of nitric acid, H. Rose[*] suggested that in particular cases the metal in the nitrate might be precipitated by means of sulphydric acid, and the nitric acid set free determined in the filtrate by volumetric methods. So far as this application of the volumetric analysis is concerned, Rose's method appears not to have been carried out in practice or even supported by actual experiment. It occurred to me that the method might be generalised so as to form the basis of a new application of the processes of acidimetry, and the following analyses will serve to show the degree of accuracy which may be attained. When the salt to be analysed contains a fixed acid which does not act upon sulphydric acid gas, a weighed portion is to be dissolved in water, the solution brought to a boiling heat, and a current of sulphydric acid gas passed through until the metal is completely precipitated. When quantities of about 5 grammes are employed the precipitation is usually complete in half an hour. The precipitate may then be allowed to settle, and a drop of the supernatant liquid taken out with a glass rod, and tested upon a white porcelain plate, with a drop of a saturated solution of sulphydric acid in water, or with any other reagent which may be specially adapted to the metal in the salt examined. The precipitation being complete the liquid is filtered upon a ribbed filter, the filtrate and the washings allowed to flow into a half litre or litre measure, and the washing with hot water continued until a drop of the filtrate no longer exhibits an acid reaction. The liquid is then allowed to cool, and the volume made up to exactly a half litre or litre by the addition of water. After thoroughly mixing the contents of the measure, fifty or one hundred cubic centimeters are to be taken out, a few drops of a solution of cochineal or logwood added, and the free acid determined by means of one-tenth normal ammonia in the usual manner. The first determination is to be used simply as a guide. Two or more successive portions of the acid liquid may then be taken out and determined successively, and the mean of several determinations obtained. With very little practice the results will be found to correspond to one-tenth c.c. when a burette with Erdmann's swimmer is employed. From the quantity of ammonia required to neutralise the acid, the quantity of acid, and in many cases also of base, in the salt may be readily calculated.

With crystallised sulphate of copper the following results were obtained.

Grms. sulphate.		Per cent acid.		Per cent base.		
1·8435	.. gave	31·89	..	31·70	..	(Sharples)
3·7183	.. ,,	32·14	..	31·93	..	,,
8·3955	.. ,,	32·10	..	31·89	..	(Tower)

The formula $CuSO_4 + 5aq$ requires ($Cu = 63·50$).

			I.	II.	III.
CuO,	..	31·86	.. 31·70	.. 31·93	.. 31·89
SO_3,	..	32·07	.. 31·89	.. 32·14	.. 32·10

The first analysis was made with a commercial sulphate, the other, with a pure salt prepared from electrotype copper. In crystallised sulphate of copper and potassium, ($CuSO_4 + K_2SO_4 + 6aq.$) 2·6601 gr. gave 18·23 per cent acid and 18·11 per cent of oxide of copper. The formula requires

			Found.
CuO,	.. .. .. 18·00	.. .. ..	**18·11**
SO_3,	.. .. .. 18·12	.. .. ..	**18·23**

In the memoir already referred to, Rose points out the necessity of diluting the solutions of metallic nitrates to such a degree that the nitric acid set free shall not act sensibly upon the sulphydric acid.

In the experiments made in my laboratory to test the method this precaution was not found to be sufficient. Thus with crystallised nitrate of lead, Mr. Sharples obtained the following results.

I. 2·147 grammes of salt were dissolved in 200 c.c. water, and the lead precipitated from the boiling solution by sulphydric acid gas. The filtrate was made up to 500 c.c., of which three portions containing each 75 c.c. were taken for titration, and each required 18·2 c.c. of ammonia. This gives 30·51 per cent of nitric acid, while the formula $Pb(NO_3)_2$ requires 32·61 per cent.

II. 2·4992 of the nitrate were dissolved in 500 c.c. of water and treated as above, only the lead was thrown down in the cold by sulphydric acid, and the excess of the latter expelled from the filtrate by boiling. The acid found corresponded to 32·12 per cent in place of 32·61. From this it is clear that even dilute nitric acid acts too powerfully upon sulphydric acid to permit a very accurate determination of the former under the circumstances of the experiment. Precipitation from a boiling solution is necessary because the filtrate is then at once free from sulphydric acid.

To obviate the difficulty arising in the case of nitric acid it occurred to me to add to the solution of the nitrate a portion of a neutral salt containing a fixed organic acid, an equivalent quantity of which would be set free by the combination of the free nitric acid with the base contained in the salt. This method was found to give perfectly satisfactory results, as the following analyses by Mr. S. P. Sharples will show.

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[*] Pogg. Ann., B. cxvi., p. 125.

4·409 grms. of nitrate of lead were dissolved in 200 c.c. of water, five or six grammes of pure Rochelle salt added, and the lead precipitated as above. The quantity of acid found corresponded to 32·58 per cent. The formula $Pb(N\Theta_3)_2$ requires

		Found.
N_2O_5	32·63	32·58
$Pb\Theta$	67·37	67·27

0·9380 grm. of nitrate of bismuth were treated as above. Rochelle salt being added. The nitric acid found, corresponded to 33·40 per cent and the equivalent quantity of oxide of bismuth to 47·82 per cent. The formula $Bi(N\Theta_3)_3 + 10$ aq. requires

		Found.
N_2O_5	33·47	33·40
Bi_2O_3	47·04	47·82

5·6553 gr. of chloride of mercury were treated as above, 6 or 8 grm. of Rochelle salt being added to the solution. The free acid corresponded to

	Calc.	Found.
Cl_2	26·20	26·10
Hg	73·80	73·90

When chlorine is separated in the form of chlorhydric acid the volatilisation of the acid in the process of boiling is completely avoided by the addition of the organic salt. The same remark applies to nitric acid, though it is probable that the principal cause of loss in this case is the action of the acid at a boiling heat upon the gas passed through the liquid. The precipitation of a metal by sulphydric acid is usually much slower when boiling solutions are employed.

The analyses given above show that, under favourable circumstances, the method employed is capable of giving satisfactory results. It is easy to see that it applies in the case of soluble definite compounds of all those metals which are easily and completely precipitated from boiling solutions by means of sulphydric acid gas. When the compound to be analysed contains an excess of free acid, not combined with the oxide of the metal to be determined, this must be first separated by evaporation to dryness in the usual manner. The presence of alkalies and alkaline earths is of course without influence on the result, but, on the other hand, even very small quantities of iron, alumina, and various other bases, make it almost impossible to determine the point of saturation with precision, these oxides in solution giving, with cochineal and logwood, specific reactions not easily distinguished from those produced by the alkalies in excess. For this reason the method does not apply when oxides of this class are present, and this case is precisely that which most frequently occurs in practice. The method will be applicable to all these cases if hereafter a colouring matter should be discovered sensitive only to acids or bases in excess, but not producing specific colouration with salts which are neutral in constitution. It is possible that cyanin, the remarkable properties of which have been described by Schönbein, or the rosocyanin of Schlumberger,[*] may fulfil the condition indicated, but I have had no opportunity of experimenting with either.

The method of precipitation above described may be used with advantage in preparing a pure normal acid for titration. Pure crystallised sulphate of copper is to be powdered and heated in a porcelain crucible placed within a Hessian crucible for about an hour, the temperature being gradually raised and not allowed to exceed a low red heat. The anhydrous sulphate is then, while still hot, to be transferred to a perfectly dry glass tube, which can be closed with a good cork covered with tin foil. After cooling, the tube is weighed, the contents poured into a flask, the salt dissolved in water, and the copper precipitated at a boiling heat as above. The filtrate and washings are then to be made up to a known volume. From the weight of the anhydrous sulphate employed, the quantity of sulphuric acid present in the solution is known. In experiments made in this laboratory by Mr. R. Chauvenet, this method has been found very accurate and expeditious.—*American Journal of Science and Arts.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 19th.

Dr. Warren de la Rue, F.R.S., &c., President, in the Chair.

The minutes of the previous meeting were read and confirmed, and the donations to the library were announced.

The following gentlemen signed the statute book, and were formally admitted as Fellows of the Society, viz., Professor Hermann Kolbe, of Leipsig; Dr. B. H. Paul, Messrs. Herbert M'Leod, J. R. Carulla, and Peter Griess.

Lieutenant Francis C. H. Clarke, Royal Artillery, Staff College, Farnborough, was proposed for election, and the names of the following gentlemen were read for the second time:—John Tyndall, LL.D., F.R.S., &c., Royal Institution of Great Britain; Frederick Guthrie, Ph.D., F.R.S.E., Lecturer on Chemistry at the Royal College of Mauritius; William Brantingham Giles, Old Swan Borax Works, Liverpool. The ballot was taken for the following gentlemen, all of whom were declared unanimously elected; Mr. R. Calvert Clapham, Walker Alkali Company's Works, Newcastle-upon-Tyne; Dr. Rustomjee Byramjee, Assistant-Surgeon in Her Majesty's Bombay Army; and Dr. Meuzel, who was elected an associate.

The names of officers and members of Council proposed for election at the anniversary meeting on Monday, 30th inst., were suspended in the meeting room.

Professor Kolbe was then invited by the President to favour the Society by giving an account of his experiments on the "*Conversion of Carbonate of Ammonia into Urea.*" The statement made by Professor Kolbe had reference to the production of artificial urea by heating in sealed tubes dry carbonate of ammonia to a degree of temperature a little lower than that at which the urea formed would be again destroyed. The speaker likewise referred to the electrolysis of acetic acid which furnished a new acid isomeric with glycolic acid, but of which the properties were as yet but imperfectly known.

Dr. **Frankland** briefly interpreted Professor Kolbe's remarks, and alluded to the interest attaching to the investigation of the new isomer of glycolic acid, which might possibly throw light upon the question of the equality of the value of the four bonds of carbon in these bodies.

Mr. **Henry Chance**, M.A., then delivered a most interesting lecture "*On the Manufacture of Glass,*" an account of which is unavoidably postponed until next week. The author briefly sketched the history of this manufacture, and quoted several analyses of various kinds of glass. The action of heat in causing devitrification, and of sunlight as affecting the colour, besides other considerations having reference to permanence, were discussed. Mr. Chance appended to his remarks upon glass a statement of his mode of treating the Rowley Rag basaltic rock of South Staffordshire. This material gives by fusion a black obsidian-like glass, which again devitrified furnishes a material suitable for building purposes, and capable of ornamental application. The formation of soluble silicate of soda by Gossage's process was described, and some of the corroded flints exhibited. An excellent series of samples illustrative of the manufacture of glass, and of the two materials producible from Rowley Rag, were laid on the table for inspection.

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[*] Bull. de la Société Chimique, Mars, 1866, p. 194.

A short discussion followed, in which Drs. Frankland, Williamson, Miller, Hugo Muller, and Messrs. Dallmayer, Church, and David Forbes, took part. The accommodation afforded by the meeting-room was as usual on this lecture evening taxed to the utmost. After votes of thanks had been passed both to Professor Kolbe and Mr. Chance, and Messrs. Duppa and Mills had been appointed auditors, the meeting was adjourned until the anniversary on Monday, 30th inst., when the President and Treasurer would present their reports.

At the next ordinary meeting, on Thursday, April 2nd, Professor Church will read a paper entitled, "*Chemical Researches on some New and Rare Cornish Minerals*;" and there will be other papers, by Messrs. Perkin and Duppa, "*On the Constitution of Glyoxylic Acid*," and by Dr. Odling, "*On Glyoxylic Amide*." On the second ordinary meeting in April, Professor Guthrie will read a paper "*On Graphic Formulæ*."

GLASGOW CHEMICAL SOCIETY.

On Monday evening last, a meeting, embracing a large representation of the chemists of Glasgow, was held in the Philosophical Society's hall, for the purpose of forming a local Chemical Society. In the absence, from illness, of Dr. Anderson, Professor of Chemistry in the University,

Wm. McAdam, Esq., of Hyde Park Pottery and Bottle Works, occupied the chair, and briefly, stated the object of the meeting, and then called upon

Mr. E. C. C. **Stanford**, F.C.S., manager of the British Sea-weed Company, who explained at some length the character of the proposed Chemical Society. He stated that the want of such a Society had long been felt among the chemists of Glasgow, and that as the Philosophical Society embraced in its membership many chemists, it had been suggested that a chemical section should be formed in the Society in accordance with the Society's rules. To this proposal the council of the Philosophical Society had readily agreed, and in order that the meetings and other privileges of the members might be open to other persons pursuing chemical studies, or engaged in chemical manufactures, they had resolved that associates should be admitted on payment of an annual subscription of five shillings, and that they should thereby be entitled to consult the Society's valuable reference library. Mr. Stanford also mentioned that he had received replies from about eighty members of the Philosophical Society, expressing approval of the projected chemical section. It was then resolved that such an organisation of the chemists of Glasgow should be formed, and a batch of eighteen associates were formally proposed and admitted, on the motion of Mr. James Mactear, F.C.S., of St. Rollox Chemical Works.

The night of meeting having been resolved upon, and Monday, the 6th of April, being fixed for the first formal meeting of the Society,

Mr. **John Mayer**, F.C.S., Government Science Teacher, proposed, and Mr. St. **John Vincent Day**, C.E., seconded, a motion—"That a council of eighteen members be elected to conduct the business of the Society, and that the council consist of a president, two vice-presidents, a secretary, and a treasurer, and thirteen ordinary members." The motion was unanimously agreed to, and in accordance with it the election was then proceeded with. The following are the names of the office-bearers:—

President: Dr. Thomas Anderson, F.R.S.E., Professor of Chemistry. *Vice-Presidents*, Dr. Wallace, F.R.S.E., Analytical Chemist; Mr. E. C. C. Stanford, F.C.S., Manager British Seaweed Company. *Treasurer:* Mr. Alexander Whitelaw, F.C.S., Soap Manufacturer. *Secretary:* Mr. R. Tatlock, F.C.S., Analytical Chemist. *Some of the other Members of Council:* Messrs. Ex. Bailie Harvey, Govanhaugh Dyeworks; James Napier, F.C.S., Chemical Manufacturer; William McAdam, Hyde Park Pottery; James Mactear, F.C.S., Alkali Department, St. Rollox Chemical Works; St. John Vincent Day, C.E.; John Mayer, F.C.S., Government Science Teacher: John Jex Long, Lucifer Match Manufacturer; John E. Poynter, Chemical Manufacturer.

We have every reason to expect that this new Chemical Society will be of much service in extending a knowledge of theoretical and practical chemistry. It would indeed be strange were it to prove otherwise, considering the chemical antecedents of the City of Glasgow, and the manufacturing district of which it is the centre. The class-rooms and laboratories of Glasgow are indissolubly associated with the names of Drs. Joseph Black, Thomas and Dundas Thomson, Thomas Clark, Birkbeck, Ure, Anderson, Penny, Professor Graham, Lyon Playfair, James Young, Greville Williams, and many others; and the chemical manufacturers of the Glasgow district furnish names not less famous in the history of chemistry. As evidence, there are the late Walter Crum; J. B. Neilson, of the hot-blast; Charles Tennant, the first manufacturer of bleaching-powder; Mushet, of the black-band ironstone; Macintosh, of waterproofing fame, &c.

We shall keep our readers apprised of anything that is novel, interesting, and important in the communications that may be made from time to time to the members of the Society, whose birth we have now put on record.

FOREIGN SCIENCE.

Paris, March 24, 1868.

Metallurgy of Iron.—Stannate of Sodium.—Oxidation of Butyric Acid.—Preservation of Meat.—Common Salt as a Manurial Agent.—Academy of Sciences.—Election of M. Bouley.—M. Le Verrier's Assistants.—Physical Properties and Calorific Power of Petroleum.—Analysis of Vegetable Tissues.—Corresponding Term to Benzoic Acid in the Naphthalic Series.—Diastase.

M. **Gillot**'s experiments on the metallurgy of iron have placed in evidence a certain number of points:—1. The theory of the reduction of silica, and the combination of the silicium with iron in the blast furnace; (2) a maximum limit which does not attain 1000° C., for the decomposition of the carbonate of lime; (3) the condition necessary for the progress of the furnace operations, viz., that each charge should furnish alone the total amount of heat required in its treatment; (4) the maximum and minimum limits: *a*, the temperature of complete combustion of the carbon at the tuyere; *b*, the mean temperature of the escaping products which result from this; *c*, the temperature of the body of the gaseous column, accruing to a charge after the conversion of the carbonic acid into carbonic oxide; finally, the temperatures and the modifications of the charge, and of the gaseous column at all stages. (5) The general cause of the transformation of bodies, of which cause cementation, oxidation, and reduction are only particular effects. (6) The principles which regulate the employment of one or of several tuyeres; (7) the theory of the employment of warm air in the blast furnace; the fact of a greater consumption of fuel with warm air than with cold; (8) the respective consumptions of heat by the pig-iron, and by the slag in blast furnaces, and in reverberatory furnaces; (9) the insufficiency of analyses of an aliquot part of the gaseous column, to determine either the composition of this gaseous column, or the reactions which take place in the furnace. Finally, M. Gillot compares the losses sustained in working the old process and the new, thus:—The losses in the carbonisation of the wood, and in the smelting of the ores, taken together, entail in the old process a minimum loss of 90 per cent of the combustible employed, and a consumption of 779 kilos. for every 100 kilos. of iron or steel manufactured. In the new processes, there are only those losses of combustible, common to all systems—loss by radiation, and by the absorption of sensible heat by the products.

MM. Moberg and Rammelsberg have shown that when a solution of stannate of sodium is evaporated, crystals containing 3 molecules of water are obtained. Since then, M. Haeffely, in re-dissolving these crystals in their mother liquor, has obtained crystals containing 8 molecules; others containing 10 molecules of water have more lately been obtained by M. Scheurer-Kestner, by submitting a weak solution of pure stannate of sodium to a low temperature. The presence of foreign salts, and especially of an excess of hydrate of sodium, prevents the crystallisation.

M. Berthelot has made some experiments upon the oxidation of butyric acid. He performed the oxidation in an alkaline solution, so as to prevent, as far as possible, the destruction of the bibasic acids. For this purpose he dissolved 10 parts of butyric acid in 1200 parts of water, in the presence of 60 parts of potassa. This liquor gradually decolourised permanganate either in the cold, or better at 100°. An experiment was made at 100°, the temperature being maintained during several days, until the butyric acid had destroyed a little more than its own weight of permanganate. The liquor then contained a considerable quantity of carbonate, oxalate, and a small quantity of succinate, not to mention acetate and propionate. To isolate the various acids, this process was adopted. First of all, the liquor was rendered acid with hydrochloric acid; it was then boiled a moment, a drop of ammonia added, and precipitated by chloride of calcium. The precipitate contained oxalate of lime, and a small quantity of an analogous salt more carbonated, probably malonate. The filtrate was evaporated on the water-bath, and the chloride of potassium eliminated by repeated crystallisations. The last residue was rendered strongly acid by hydrochloric acid, and agitated at several intervals with a considerable volume of purified ether. Evaporated to dryness, the ether left a crystalline acid, possessing the properties of, and reacting like, succinic acid. This fact has been verified by the solubility of the lime-salt in water, and by the precipitate occasioned upon the addition of alcohol; the properties of the magnesian salt, the precipitation of the neutral perchloride of iron by the solution of succinate of magnesia, &c., have also lent confirmation. The amount of succinic acid formed is very inconsiderable.

M. Martin has made some experiments upon the preservation of meat by means of ether. He placed in six tin boxes uncooked beef, surrounded by little tufts of cotton wool soaked in sulphuric ether; the boxes were then soldered tight, and exposed to the rays of the sun. Every three months a box was opened. Each piece of meat weighed a kilogramme. At the end of three months there was no alteration either in weight or form. The meat thus preserved does not undergo the putrid fermentation; it is strongly impregnated with ether, and the odour remains after numerous washings with cold water. When cooked the meat possesses a peculiar savour, probably due, M. Martin says, to the formation of a new ether: the fibre is disintegrated. The process is not applicable to the preservation of food, but other animal matters might perhaps be advantageously treated by it.

M. Jean has proposed the following as the mode of action of common salt employed as a manurial agent (considering all the salts likely to be present in the soil). The carbonate of lime decomposes the ammoniacal salts, transforming them into carbonate of ammonia; this carbonate meets in the subterraneous atmosphere with carbonic acid gas produced by the decomposition of organic matters, and forms bicarbonate; then if this salt finds chloride of sodium in the soil, a double decomposition is established, giving rise to chloride of ammonium and carbonate of soda. The chloride of ammonium, in its turn, is decomposed by carbonate of lime, yielding chloride of calcium, which passes into the sub-soil, and carbonate of ammonia. The carbonate of soda thus produced determines the decomposition of nitrogenous organic matter, and facilitates nitrification. The transformation of chloride of sodium into carbonate of soda takes place so readily that MM. Truck and Schlœsing have applied this reaction in the manufacture of carbonate of soda.

At the meeting of the Academy of Sciences held on the 2nd of March, the election of a member in the place vacant in the section of rural economy, was proceeded with. M. Bouley was the successful candidate. The meeting was essentially stormy. M. Deville had at the previous meeting defended in very energetic terms M. Foucault against some imputations M. Le Verrier had cast upon his memory. M. Le Verrier denied at this meeting that he had any other purpose than to do the amplest justice to, and exalt the fame of, the illustrious deceased. Afterwards another question became involved. The president, M. Delaunay, considered it right that the name of the assistant who discovered the 96th little planet should be made known; he said: "I have the honour to inform the Academy that the young man to whom the discovery of the 96th little planet is due, is M. Coggia." M. Le Verrier replied that only one result could follow from M. Delaunay's remarks—disorder in the observatory of Marseilles. He said that the young gentlemen who discovered planets at Marseilles did not deserve to be cited; the work they did was simply manual, and required no knowledge of astronomy. They were very well satisfied, he also said, with their condition; they received for every planet discovered an increase in salary of 250 fr., and a gold medal. A general protest from the members followed this statement.

M. Deville brought before the Academy at the *seance* of the 9th March, a memoir on the physical properties and the calorific power of petroleum and mineral oils. A large number of samples were experimented with. The mineral oil was submitted to distillation in a copper alembic furnished with a long serpent tube, and also with a thermometer. By means of this apparatus the amount of distillate passing over at various temperatures was estimated. The danger possible by explosion was measured by the proportion distilling below 140°. The same experimental fact represents as well the loss which must be sustained to remove the explosive property of the oil. Another danger is encountered when the oils are enclosed in air-tight vessels—explosion by dilation. The amount of space necessary to be left above a mineral oil is calculated from the coefficient of dilation. The data M. Deville has obtained from each sample are drawn generally from the following determinations. Loss by heating to 100°, to 120°, and so on, by intervals of 20° up to 200°; this is expressed in percentages. Composition of the oil, *i.e.*, percentages of carbon, hydrogen, and oxygen, obtained by combustion. Density at zero, and at 50°, and coefficient of dilation. Composition and density of the oil obtained by distillation, and density of the residue. In some cases the specific heat has been determined, and the latent heat at the mean temperature. M. Deville's memoir contained tables giving an immense number of experimental results; it is, however, only a first memoir; more upon the subject will be brought before the Academy shortly. Perhaps it will not be without interest to tell your readers that M. Deville has undertaken this research by command of the Emperor, to report upon the most advantageous arrangements to adopt for the economic and safe employment of mineral oils, with especial reference to its use in transports. M. Elie de Beaumont drew M. Deville's attention to a blackish schist which occurs at Vassy, near Avallon, as a source of oily matter; this schistous substance extends over a very large area.

MM. E. Fremy and Terreil contributed, at the same meeting, a memoir upon a general method for the immediate analysis of vegetable tissues. In wood they recognise the existence of three principles. The first component cannot be easily mistaken; it is insoluble in sulphuric acid, containing two equivalents of water; it is further transformed by chlorine water into a yellow substance, and afterwards dissolved, nitric acts in the same way as chlorine; it is not soluble in potash solution, either dilute or concentrated. The substance is distinguished by the name of the ligneous cuticle; it has also been designated by M. Hartig by the name of *eustathe*, in consequence of its great stability. The second component of ligneous tissue has been studied by M. Payen, under the name of *incrusting* substance: qualitatively, they recognise its existence by its solubility in sulphuric acid, which becomes blackened, and afterwards by its insolubility in alkaline solutions and in chlorine water. The third component is cellulose. When pure, cellulose dissolves without giving rise to colouration in concentrated sulphuric acid, and water does not precipitate it from the solution; it is difficultly attackable by chlorine water, and by nitric acid. They detail in their memoir the actual process. 1 grm. of the sawdust dried at 130° is introduced into a flask, with about a litre of chlorine water, and allowed to remain here for thirty-six hours. The chlorine water dissolves the ligneous cuticle and certain parts of the encrusting matter; it leaves in an insoluble state, cellulose mixed with a part of the encrusting matter, which has been transformed into an acid completely soluble in potash. This residue left by the chlorine water is, therefore, treated with an alkaline solution, afterwards washed with acid, then with water, and finally dried at 130°. Cellulose is thus obtained in a state of absolute purity. Determinations gave 40 cent of this substance for oak wood, and 39 per cent for the wood of the ash. For the determination of the ligneous cuticle, they take again 1 grm. of sawdust, and submit it to the action of sulphuric acid, containing 4 equivalents of water, for thirty-six hours; the portion which it is required to estimate alone remains insoluble; in some cases they replace the acid by other containing only 2 equivalents of water. The residue is washed with water and with an alkaline solution until the washings are no longer coloured; it is then dried. They take the precaution of testing the purity of the ligneous cuticle weighed; when pure it dissolves without residue in chlorine water or in nitric acid. The incrusting matter is determined by difference. But this part of the wood is composed of several substances, and they separate them thus:—(*a*) matter soluble in boiling water; (*b*) bodies, probably of the nature of pectose, which dissolve in dilute solutions of alkali; (*c*) matter rendered soluble in alkaline solutions, by treatment with moist chlorine. For instance, in the ligneous tissue of oak wood, they estimated the encrusting matter by difference, at 40 per cent; then they found *a* 10 per cent, *b* 15 per cent, and *c* 15 per cent.

Dr. A. W. Hofmann contributed a memoir on the corresponding term to benzoic acid in the naphthalic series, M. Payen, a memoir entitled "extraction and properties of diastase"; there were also several other very interesting papers, accounts of which will probably be introduced in your correspondent's next letter.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Toluolsulphurous Acid.—R. Otto (second communication). The action of phosphoric perchloride upon tuluolsulphurous acid gives rise to the formation of sulphotoluolic chloride, fusing at 68—69° C., and an oily body not obtained in sufficient quantity for examination. Nascent hydrogen forms metabenzylic sulphydrate:

$$\left.\begin{matrix}C_7H_7S\Theta\\H\end{matrix}\right\}O + 4H = 2H_2O + \left.\begin{matrix}C_7H_7\\H\end{matrix}\right\}S$$

identical with that of Märker (*Ann. Chem. Pharm.*, cxxxvi., 75). When heated with water to 120—130° toluolsulphuric acid and oxybenzoldisulphide, $C_{14}H_{14}S_2O_2$ is obtained. Potassic hydrate at 250—300° causes it to split into sulphite and toluol. Fuming nitric acid forms the compound $C_{21}H_{22}N_2S_3\Theta_5$, which may be looked upon as diazotrisulphotoluolic hydride, and besides this, nitrosulphotoluolic acid.—(*Zeitschr. Chem.*, N.F. iii., 600).

Oxidation of Benzol.—L. Carius. Benzol is readily oxidised by a mixture of manganic dioxide and sulphuric acid (5 acid, 1 water). Amongst the products of the oxidation were found benzoic acid, and a new diabasic acid of the composition $C_6H_4\Theta_3$—oxybenzenic acid, *i.e.*, benzenic acid + 1 atom of oxygen. Oxybenzenic acid is sparingly soluble in water, fuses at 175° C., and distils undecomposed at 250°. The author considers it extremely probable that this acid is identical with phtalic acid, their composition, as found by analysis, differing but little, and fusion-point (phtalic acid, according to C., fuses at 175°, not at 120°) and solubility being the same with both. The formation of benzoic acid in this case is of interest as being the first in which, by simple oxidation of a hydrocarbon, an acid richer in carbon is obtained; this is due evidently to the presence of formic acid, which is formed during a certain stage of the reaction:

$$CO,H,OH + C_6H_5H = CO,\ C_6H_5,\ OH + OH_2.$$

—(*Ibid*, N.F. iii., 629.)

Derivatives of Mesitylene, containing Sulphur.—A. Holtmeyer. Mesitylensulphuric chloride, $C_9H_{11}S\Theta_2.Cl$, is formed by the action of phosphoric perchloride on sodic mesitylensulphate. It dissolves in ether and alcohol, is insoluble in water, fuses at 57° C. Sodium amalgam converts it into mesitylen sulphurous acid, $C_9H_{11}S\Theta_2.H$, soluble in alcohol and hot water, sparingly so in cold water, fuses at 98—99°. Mesitylensulphydrate $C_9H_{11}SH$ is obtained by adding the chloride to a heated mixture of zinc and sulphuric acid; it is a liquid boiling at 228—229°, soluble in alcohol, ether, or benzol, insoluble in water. The sulphydrate may be converted into mesitylendisulphide by adding to its alcoholic solution aqueous sodic hydrate. The disulphide fuses at 125°, its solubility in alcohol, &c., is the same as that of the sulphhydrate.—(*Ibid*, N.F. iii., 686.)

Reactions of Anisic Aldehyde.—Saytzeff and Samosadsky. If anisic aldehyde in alcoholic solution is digested with sodium amalgam two crystalline bodies are obtained. The one fuses at 172° C. is little soluble in cold, readily in hot alcohol or ether. Its composition is $C_{16}H_{18}\Theta_4$, being intermediate between anisic aldehyde and alcohol; it seems to be the doubled aldehyde combined with 2H—analogous to the compound obtained by Hermann from benzoic acid with sodium amalgam. The second compound fuses at 125°, but otherwise resembles the first closely, and is supposed to be the doubled aldehyde—analogous to benzoin.—*Ibid*, N.F., iii., 678.)

Harmless "Pharaoh's Serpents."—A new method of making the curious chemical toys called "Pharaoh's Serpents" has been suggested by Vorbringer. The black liquor which results as a useless product when coal oil is purified with sulphuric acid, is to be treated with fuming nitric acid. The dark-coloured resinous matter which swims on the surface is then collected, washed and dried, when it forms a yellowish-brown mass having about the consistency of sulphur which has been melted and poured into water. When this mass is ignited it undergoes such a wonderful increase in bulk that a cylinder one inch long will give a snake about four feet in length. The briefness of the popularity enjoyed by the "original" serpents was due to the unhealthy vapours given off in the process of burning.—*Scientific American.*

CORRESPONDENCE.

CONTRACTION ON SOLIDIFICATION.

To the Editor of the Chemical News.

Sir,—During the discussion on "devitrification," at the close of Mr. Chance's interesting lecture at the Chemical Society, Mr. Forbes mentioned that Mr. Chance, at his suggestion, compared the measurements of the wooden frames used for making the moulds for casting certain blocks of basalt, with the blocks so prepared when cold, and it was ascertained that the frames and blocks corresponded in size, from which it was inferred that molten basalt suffers neither contraction nor expansion on solidification.

A short time since, I made a few observations on the cooling, after fusion, of some six or seven crystalline substances, and I noticed that, with the exception of bismuth, they *contracted* on solidification. The contraction, however, did not manifest itself, generally, by making the solidified masses smaller than the interior of the vessels in which the substances cooled; but by the formation of cavities, sometimes of considerable size.

The experiments referred to, were made with comparatively very small quantities of the various substances, the fusing points of all being far lower than that of basalt; still, as there was a considerable difference in their fusing points as well as in the amounts employed, I think it extremely probable were the blocks in question carefully examined, cavities would also be found in them, or on their surfaces, which in conjunction with the facts already elicited, would, I believe, settle the interesting question whether or not contraction takes place during the solidification and devitrification of basalt.—I am, &c.,

Alfred Tribe.

149, Gt. Portland Street. March 23, 1868.

ESTIMATION OF PHOSPHATES.

To the Editor of the Chemical News.

Sir,—As this is the season when so many persons are interested in the manufacture and composition of artificial manures, perhaps the following popular explanation of Mr. Burnard's process will serve as an answer to several of your correspondents and readers, and will be of use to any intelligent chemist and druggist, as an extremely simple mode of estimating their phosphatic value.

I take for granted that phosphate of lime consists of 3 equivalents of lime ($3CaO$) and 1 equivalent of phosphoric acid (PO_5), and is converted into biphosphate by the addition of 2 equivalents of sulphuric acid ($2SO_3$). The following diagram will exhibit this interesting reaction:—

$$\begin{array}{c} \text{Neutral} \\ \text{phosphate} \\ \text{of lime.} \end{array} \left\{ \begin{array}{r} \text{1 eq. phosph. acid} \\ \\ \text{3 eq. lime} \\ \end{array} \right. \begin{array}{r} PO_5 = 72 \\ \left\{ \begin{array}{r} CaO = 28 \\ 2CaO = 56 \end{array} \right. \end{array} \begin{array}{l} \left. \vphantom{\begin{array}{c}a\\b\end{array}} \right\} \text{Biphosphate.} \\ \left. \vphantom{\begin{array}{c}a\\b\end{array}} \right\} \begin{array}{c}\text{Sulphate of} \\ \text{lime.}\end{array} \end{array}$$

$$\text{2 eq. sulph. acid} \quad 2SO_3 = 80$$

Here we see 2 eq. of sulphuric acid combine with 2 eq. of lime to form sulphate of lime, while the remaining equivalent of lime combines with the phosphoric acid to form biphosphate of lime.

Mr. Burnard, in his ingenious process, recommends 100 gr. of the manure to be tested to be added to 2 pints of water; and this large quantity of water is employed that sufficient of the sulphate of lime may be taken up by the water, to afford lime by its decomposition with soda for combination with the biphosphate, which is also in solution. The following is the exact method I have adopted in working out Mr. Burnard's process:—I have a measure holding 1000 gr. of water; it is, in fact, a piece of glass tube, about half an inch in diameter, stopped at one end, and divided into 100 equal parts; consequently each division represents 10 gr. of water. I then dissolve 10 gr. of neutral carbonate of soda in rain-water, and make it up to 1000 gr. This constitutes my test solution of soda; every ten divisions of the measure represents exactly 1 gr. of soda. I then take another glass tube, about 1 ft. long and ¼th of an inch diameter, stopped at one end with a plug of gutta percha, which is perforated with a pin; the object of this tube is to add the test solution of soda, drop by drop, at the termination of the operation, when great nicety is requisite; this may be effected by applying the finger at the other end of the tube.

I now proceed to test, agreeably to the recommendation of Mr. Burnard, one half of the solution, or one pint, with my small tube, graduated into four divisions, so that each division represents $\frac{1}{10}$th of a grain of soda. It may require soda solution equal to about ten divisions of the small drop tube (or 1 gr. of soda) to neutralise the free sulphuric acid that may be present in the solution operated upon; but this is readily ascertained by adding the test solution gradually, and so long as the liquor remains quite clear when well agitated by stirring; directly the liquor assumes a slight milky appearance, the free sulphuric acid is neutralised, and the conversion of the biphosphate in solution into neutral phosphate is beginning, the milkiness being occasioned by the precipitation of phosphate of lime through the decomposition by the soda of the sulphate of lime in solution.

At this time a piece of blue litmus paper, fastened to a piece of cork, must be put into the liquor, when it instantly becomes red. Having noted the exact quantity of soda solution employed to neutralise the free acid, more of it may now be added gradually, until the liquor begins to show an alkaline reaction, constantly stirring the whole time; this will be readily seen by the litmus paper assuming a bluish colour. We will now suppose that 1 gr. of soda has been employed in neutralising any free acid that may be present, and 12 gr. have been employed in decomposing the sulphate of lime for the precipitation of all the biphosphate as neutral phosphate; it now remains to estimate the quantity of biphosphate in the 100 gr. of manure.

Now, 1 equivalent of carbonate of soda (53) combines with 1 equivalent of anhydrous sulphuric acid (40) to form sulphate of soda. Consequently, we have this proportion—as 53 is to 40, so is the 12 gr. of soda to the quantity of anhydrous sulphuric acid employed in the conversion of the neutral phosphate of lime into biphosphate, which is 9·05; but as we have only tested half the liquor, the whole will show 18·1 gr. as the quantity of anhydrous sulphuric acid employed in the 100 gr. of manure.

Again, our diagram shows that 80 parts of anhydrous sulphuric acid are necessary to form 100 parts of biphosphate; consequently, we have this further proportion to show the percentage of biphosphate contained in the 100 gr.

As 80 : 100 :: 18·1 : to the percentage of biphosphate formed by the 18·1 gr. of anhydrous sulphuric acid, which shows the manure to contain about 22½ per cent of soluble or biphosphate of lime.

As this is not intended for your professional readers, I hope it may not be considered two tedious for the pages of your valuable publication.—I am, &c.

W. Little.

Heckington Hall, Lincolnshire.

MISCELLANEOUS.

Absorption of Arsenic, Tungstic, and Arsenious Acids from Solution by Charcoal—In a former number of the CHEMICAL NEWS, I stated that charcoal absorbed nitric acid from sulphuric acid; I have since found that it also absorbs the substances here specified under, the following circumstances. If a few drops of a solution of a salt of arsenic, or arsenious acid, is put into a few ounces of dilute sulphuric acid and the mixed solution agitated at intervals with recently ignited charcoal for an hour or two, the clear liquid obtained by filtration does not manifest any reaction of arsenic when tested by Marsh's process. Lignite has not the same effect as charcoal, though absorbent of weak acids and bases generally, as I have before shown. Tungstic acid also from acid solutions is removed by charcoal applied in like manner, and is given up to a solution of caustic alkali.—W. SKEY.

Use of the Lime-Light in Barracks.—On Monday evening a series of experiments with the lime-light were conducted in the Queen's Barracks, Perth, with the view of testing the practicability of its introduction instead of gas, the Horse Guards having resolved to discontinue the use of gas in the Perth barracks, owing to its recent rise to 6s. 8*d*. per 1,000 feet. The experiments were made in the open air, in one of the lobbies extending the whole length of one of the wings of the barracks, and in one of the ordinary barrack-rooms. An apparatus, about 20 feet high, was erected in the square, having at the top an appliance for showing off the light, and a reflector above. When the flame was applied and the light regulated, the entire square was lighted up almost as clear as noonday, it being quite easy to read the smallest print at a distance of 100 yards. In the lobby a light of small size was used, covered with a glass globe, and the flame burned so brightly that a pin might have been seen on the floor at the extreme end of the lobby, a distance of fully 30 yards. The company then adjourned to one of the ordinary barrack-rooms, where a very small apparatus was fitted up; and, on the light being applied, the room was lighted up much more brilliantly than it would have been by gas. In fact, if there was any fault, it was that the light was too brilliant for the size of the room. The experiments were witnessed by a scientific gentleman from London sent by the War Office, and by the colonel commanding the Royal Engineers in Scotland, both of whom expressed themselves highly satisfied. We understand that contracts have been entered into for using it in the camp at Aldershot, and Government intend shortly to introduce it into all the barracks in the country.—*Edinburgh Courant.*—*Journal of Gas-Lighting.*

NOTES AND QUERIES.

Safflower.—Would any of your correspondents be good enough to enlighten me how to extract the colouring matter from safflower for dyeing pink?—G. JOHNSON.

Distillation of Grease.—Is there any Treatise published on the distillation of greases and animal and vegetable oils?—DAVID SHAW & Co.

Oxychloride of Magnesia.—If Mr. J. E. Hamilton is still looking for a supply of this article, he may hear of a cheap source by applying to the Publisher.

Production of Carbonic Acid.—In reply to "G.," in the CHEMICAL NEWS of the 13th inst., I beg to inform him that he may obtain carbonic acid very readily from limestone, marble, or chalk, at a low red heat, by passing a current of steam over them at that temperature.—W. H. POTTER.

Preservation of Meat.—Several sheep, killed in England, and preserved by Professor Gamgee's process, have been exhibited in New York last week in an excellent state of preservation. Would you please to give, through your CHEMICAL NEWS, or otherwise, a description of Prof. Gamgee's process, and the mode in which it is carried into effect?—A. G. HUNTER, Fair Haven, Connecticut, U.S.

Laboratory Stove.—Preserving Insects.—Can any of your correspondents tell me—1st, What do they consider the best laboratory stove? My present fire-place, besides being useless for heating a crucible, raises such a daily dust as seriously to interfere with analysis (chiefly agricultural analyses). 2nd, I have some eastern insects preserved in spirits in small glass bottles, but the spirit has softened the sealing-wax, and evaporated, leaving the insects dry and very brittle. What am I to do?—C. D. H.

Explanation, to Mr. S. A. S.—In the CHEMICAL NEWS, of March 6, you very severely take me to task, and criticise, 1st, the short hint I gave in "Notes and Queries" (CHEMICAL NEWS, No. 429); and 2nd, the equally very brief note of mine "On the Approximative Determination of Sulphur in Pyrites" (CHEMICAL NEWS, No. 428). Permit me to observe that your presumption of my ignorance is, in both cases, not proved by facts. I consider "Notes and Queries" only to be intended for short and brief hints; moreover, one might offend querists by supposing them not to be sufficiently well up in analysis to enable them to think and judge for themselves. Certainly, I think it would be quite out of place to expect "Notes and Queries" to contain full directions in every respect. As regards analysis of superphosphates, I am as well aware as the most prominent analyst in such matters, that, without full and thoroughly complete analysis, what I wrote about the estimation of free sulphuric acid would be leading to gross errors. As regards your objection to the approximative valuation of sulphur in pyrites, permit me to say that I thought it unnecessary to add, that I always and invariably, after having for some time ignited the previously-weighed pyrites, allow it to cool, then moisten it with pure nitric acid, expose again to heat with due precautions, and repeat this process at least from three to four times, when nothing but peroxide of iron will remain. My only reason for not mentioning this is, that I considered any one might think of it.—Dr. A. ADRIANI.

MEETINGS FOR THE WEEK.

MONDAY.—Medical, 8.
— Chemical, 8. Anniversary Meeting.
TUESDAY.—Royal Institution, 3. Dr. M. Foster, "On the Development of Animals."
WEDNESDAY.—Society of Arts, 8.
— Pharmaceutical, 8.
THURSDAY.—Royal Institution, 3. Dr. M. Foster, "On the Development of Animals."
— Royal, 8½.
— Chemical, 8. 1. "Chemical Researches on some New and Rare Cornish Minerals," by Prof. Church. 2. "On the Constitution of Glyoxylic Acid," by Messrs. Perkin and Duppa. 3. "On Glyoxylic Amide," by Dr. Odling.
— Royal Society Club, 6.
FRIDAY.—Royal Institution, 8. Prof. Frankland, "On the Proposed Water Supply for the Metropolis."
— Geologists' Association, 8.
SATURDAY.—Royal Institution, 3. Professor Roscoe, "On the Non-Metallic Elements."

TO CORRESPONDENTS.

Enquirer.—Liebig's process for silvering glass is well known, and has been more than once described in these pages. Some improvements have been lately introduced, which we will give in a few weeks.

North.—We are not aware that such a work exists. Consult the articles in "Watts's Dictionary," and in the text books.

Gaskell, Deacon and Co.—We will communicate with our Paris correspondent, and endeavour to ascertain further particulars.

Drysalter.—See answer to "*North.*"

A. G. Hunter, U.S.—Permanganate of soda will do, but we think sulphate of magnesia should also be employed.

Communications have been received from Gaskell, Deacon and Co.; W. H. Walenn; Dr. Adriani (with enclosures); M. Scott; A. G. Hunter; F. C. Correy (with enclosure); Norman MacLeod (with enclosures); F. Sutton; G. Johnson; W. H. Potter; C. Hunter (with enclosure); Drs. Wischin and Wilm (with enclosure); W. M. Watts (with enclosure); T. R. Fraser, M.D.; W. Chapman (with enclosure); Mr. Hargreaves (with enclosure); Dr. Sheridan Muspratt; A. Sarl; T. Reader; W. Smyth (with enclosure); J. Carter Bell (with enclosure); G. Foord, Victoria; J. Burton; J. Mayer (with enclosure); Dr. Letheby (with enclosure); F. H. Hobler; R. Lyle; David Shaw and Co.; W. Little (with enclosure); Baxter, Rose, Norton and Co.; José Piodela; A. Tribe (with enclosure); A. Coppins; J. Browning; T. A. Readwin (with enclosures); F. Stanford; T. Dorn (with enclosure); J. Van Voorst; Nicholson and Maule; J. C. Wilson; C. M. King; A. S. Herschel; Dr. W. B. Herapath, F.R.S. (with enclosure); Dr. Apjohn; C. M. King; W. B. Giles; Captain W. A. Ross, R. A.

Books received.—"A Sketch of a Philosophy, Part II.—Matter and Molecular Morphology:" London, Williams & Norgate; "*Zeitschrift fur Chemie*;" "Le Maraviglie Della Scienza;" "Recollections of the Paris Exhibition of 1867," by Eugene Rimmel. London: Chapman & Hall."

In Liquidation.—Re The London Chemical COMPANY (Limited). First portion of the Valuable Stock and Effects upon the Works, being the loose things in and about the premises. Messrs. STANLEY, ROBINSON, and PALMER are instructed by the Official Liquidator to SELL BY AUCTION, at the Works, Crockleford (3 miles from Colchester), on Thursday and Friday, April 2nd and 3rd, 1868, at Twelve for One o'clock precisely, the first portion of the Valuable Stock and Effects, consisting of Nitre Salt, Salt Cake, Glauber Salt, Molasses, Sulphur, Charcoal, Fire Clay, Ivory Black, 20 tons of Soda, 10,000 gallons of Vitriol and Tartaric Acid in liquors, 2,000 tons of Sulphate of Lime, quantity of useful Timber, Rod, Bar, and Old Iron, Cornish Boiler, 20 tons of Copper and Lead, Carboys, Mill Stones, Brown Paper, Iron-bound Tanks lined with Lead, Blacksmiths', Carpenters', Coopers', Plumbers', and Gas Fitters' Tools, Leather and India-rubber Driving Bands, Office Furniture, and numerous other Effects. May be viewed the day preceding and Mornings of Sale, and Catalogues had of Messrs. Hillyer and Fenwick, Solicitors, 12, Fenchurch Street; of Messrs. Frederick B. Smart and Snell, Accountants, 38, Gresham Street, E.C.; at the place of Sale; and of the Auctioneers, where Samples of the Stock may be seen, 11, Ironmonger Lane, Cheapside, E.C.

Important Sale by Public Auction.—On the 8th of May, a.c., will be offered for PUBLIC SALE, at BUCKAU, near Magdeburg, in the Province of Saxony, in PRUSSIA, the CHEMICAL WORKS, established for twenty-five years, and now at work. It is situated immediately contiguous to the Railway Station, on the border of a small navigable river, which, within a few hundred feet, joins the river Elbe. It is only a few miles distant from the Stassfurt Rocksalt Mines and Coal and Limestone Fields. Being situated in the midst of the Beet-root districts, its position is particularly advantageous.

The establishment produces chiefly Sulphuric Acid, Soda, and Chloride of Lime, for the manufacture of which there are:—

4 Lead Chambers, of an aggregate contents of 220,000 cubic feet.

1 Platinum Apparatus, capable of producing 60 cwt. of Concentrated Acid per day.

2 Sulphate Furnaces.

4 Soda Decomposing Furnaces.

8 Chloride of Lime Chambers.

Besides those there are—

2 Muriatic Acid Condensing Towers.

4 Apparatus for Refining Sulphur, and the complete Plant for the Production of Saltpetre, Aquafortis, Copperas, and Manures.

By means of the above-mentioned 4 Lead Chambers, about 4,000 tons of Acid can be manufactured per year.

The Soda Plant produced last year about 1,500 tons of Calcined and Caustic, and 750 tons of Crystals of Soda.

The Muriatic Acid finds a profitable sale among the numerous sugar refineries surrounding this establishment.

Labour is cheap, amounting to about 15 to 17½ silbergroschen for 12 hours' work.

6 Steam Boilers and 2 Steam Engines are employed.

Any further information can be had of Mr. Wilke, Solicitor, at Magdeburg.

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Scholl's Patent Platinum Gas Light Perfecter. —Extract from Report by Dr. Letheby:—

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THE CHEMICAL NEWS.

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ON

THE SPECTRUM OF THE BESSEMER FLAME.

In our number for March 21st, we quoted an article from *Engineering*, giving the results of Professor Lielegg's observations on the spectrum of the Bessemer-flame. As these results were published in *Engineering* as entirely new, and no mention was made of any prior observations, it is only right that attention should be called to the fact that as long ago as 1862 the same results had been obtained by Professor Roscoe, and were published in the form of a short preliminary notice in the *Proceedings* of the Manchester Literary and Philosophical Society, for February 24th, 1863. As the note is extremely short, we transcribe it in full.

"Professor Roscoe stated that he had been for some little time, and is still, engaged in an interesting examination of the spectrum produced by the flame evolved in the manufacture of cast steel by the Bessemer process, on the works of Messrs. John Brown and Co., of Sheffield. The spectrum of this highly luminous and peculiar flame exhibits during a certain phase of its existence a complicated but most characteristic series of bright lines and dark absorption-bands. Amongst the former the sodium, lithium, and potassium lines are most conspicuous; but these are accompanied by a number of other, and as yet undetermined, bright lines; whilst among the absorption-bands, those formed by sodium vapour and carbonic oxide can be readily distinguished. Professor Roscoe expressed his belief that this first practical application of the spectrum analysis will prove of the highest importance in the manufacture of cast steel by the Bessemer process, and he hoped on a future occasion to be in a position to bring the subject before the Society in a more extended form than he was at present able to do."

In a lecture delivered before the Royal Institution (May 6, 1864) a year later than the communication quoted above, Dr. Roscoe described the Bessemer-spectrum more fully, and pointed out the existence of lines produced by carbon, iron, sodium, lithium, potassium, hydrogen, and nitrogen.

An important practical result of the observations on which these communications were based, was the discovery that the exact point of decarbonisation could be determined by means of the spectroscope with much greater exactitude than from the appearance of the flame itself, the change in which indicating the completion of the process is minute, and requires a lengthened experience to detect with certainty. This method of determining the point at which it is necessary to stop the blast was indeed at that time (1863) in constant use at Messrs. Brown's works, at Sheffield, and has since been introduced with equal success by Mr. Ramsbottom (at the suggestion of Dr. Roscoe) at the London and North Western Railway Company's steel works, at Crewe.

Dr. W. M. Watts now draws our attention to a paper "On the Spectrum of the Bessemer-flame," which he published in the *Philosophical Magazine* for December last. In it he states that he was at that time acting as assistant to Professor Roscoe, and in that capacity conducted a lengthened examination of the Bessemer spectrum at the works at Crewe. The results of that investigation were not published at the time, on account of their incompleteness; and he has since then continued in Glasgow the same research, which has now extended itself into an inquiry into the nature of the various spectra produced by the carbon compounds. These experiments are still incomplete; but under the circumstances of the publication of Professor Lielegg's papers, he has put together a few of the more important results obtained in the examination of the Bessemer-spectrum.

The changes which take place in the spectrum from the commencement of the "blow" to its termination are extremely interesting. When the blast is first turned on, nothing is seen but a continuous spectrum. In three or four minutes the sodium-line appears flashing through the spectrum, and then becoming continuously visible; and gradually an immense number of lines become visible; some as fine bright lines, others as intensely dark bands; and these increase in intensity until the conclusion of the operation. The cessation of the removal of carbon from the iron is strikingly evidenced by the disappearance of nearly all the dark lines and most of the bright ones.

The spectrum is remarkable from the total absence of lines in the more refrangible portion; it extends scarcely beyond the solar line *b*.

The occurrence of *absorption*-lines in the Bessemer-spectrum is in itself extremely probable; and that this is the case appears almost proved by the great intensity of some of the dark lines of the spectrum. It was with this view that the investigation was commenced, with the expectation that the spectrum would prove to be a compound one, in which the lines of iron, carbon, or carbonic oxide, &c., would be found, some as bright lines, others reversed as dark absorption-bands. To a certain extent this anticipation has been verified; but the great mass of the lines, including the brightest in the whole spectrum, have not as yet been identified.

In dealing with a complicated spectrum like that of the Bessemer-flame, it is indispensable that the spectrum should be actually compared with each separate spectrum of the elements sought. This was the plan actually pursued; the spectroscope was so arranged that the spectrum of the Bessemer-flame was seen in the upper half of the field of view, and the spectrum with which it was to be compared was seen immediately below. In no other way can any satisfactory conclusion be obtained as to the coincidence or non-coincidence of the lines with those of known spectra.

The spectrum of the Bessemer-flame was thus compared with the following spectra:—

(1) Spectrum of electric discharge in a carbonic-oxide vacuum.
(2) Spectrum of strong spark between silver poles in air.
(3) ,, ,, iron ,,
(4) ,, ,, iron poles in hydrogen.
(5) Solar spectrum.
(6) Carbon spectrum—oxyhydrogen blowpipe supplied with olefiant gas and oxygen.

The coincidences observed were, however, but very few and totally failed to explain the nature of the Bessemer-spectrum. The lines of the well-known carbon-spectrum do not occur at all, either as bright lines or as absorption-bands; nor was any coincidence observed between the lines of the Bessemer-spectrum and those of the carbonic-oxide vacuum tube.

The lines of lithium, sodium, and potassium are always seen, and are unmistakeable.

The three fine bright lines 73·7, 76·8, and 82 are due to *iron*. The red band of hydrogen is seen as a black band, more prominent in wet weather.

After the charge of iron has been blown, it is run into the ladle, and a certain quantity of the highly-carbonised *spiegeleisen* is run into it. The effect of the addition of the spiegeleisen is the production of a flame which is larger and stronger when the blow has been carried rather far. This flame occasionally gives the same spectrum as the ordinary Bessemer-flame; but more commonly a quite different spectrum is seen, which reminds one at first of the ordinary carbon-spectrum, but differs from it very remarkably.

In the carbon-spectrum, each group of lines has its strongest member on the left (*i.e.* less refrangible), and fades gradually away towards the right hand: in the spectrum of the spiegel-flame the reverse is the case; each group has its brightest line most refrangible, and fades away into darkness on the least-refracted side. A comparison of the drawing of the spectrum of the spiegel-flame with that of the Bessemer-flame will show that they really contain the same lines; but the general appearance of the spectrum is completely changed by alteration of the relative brightness of the lines. This was shown by direct comparison of the actual spectra.

Dr. Watts concludes his paper in the *Philosophical Magazine* by saying—"There can be no doubt that the principal lines of the Bessemer-spectrum are due to carbon in some form or other. My own belief is that they are due to incandescent carbon-vapour. The experiments in which I am at present engaged have already shown the existence of *two* totally different spectra, each capable of considerable modification (consisting in the addition of new lines) corresponding to alterations in the temperature or mode of producing the spectrum, and each due to incandescent carbon. It is possible that the Bessemer-spectrum may prove to be a third spectrum of carbon, produced under different circumstances from those under which the ordinary carbon-spectrum is obtained; and the intensity of the dark bands is more probably due to contrast with the extreme brilliancy of the bright lines, than to their actual formation by absorption."

COAGULATION AND PRECIPITATION OF CLAY BY NEUTRAL SALTS GENERALLY.

By WILLIAM SKEY,
Analyst to the Geological Survey of New Zealand.

A great many substances are recommended as substitutes for filtration in the clarifying of water turbid from the presence of clayey matter, but so far as I can learn, they all depend for their individual effects upon some chemical interchange between themselves and a portion of the clayey matter in suspension, or upon the formation of a new compound out of the elements of the agent employed; in either case the clay, or the residue of the clay, being carried down mechanically, entangled in the newly formed substance. The object of this communication therefore is to bring under notice that several neutral salts, having their component parts so strongly combined among themselves as to render their decomposition by clay apparently impossible, are individually capable of producing the same effect upon clay in suspension; thus a strong solution of chloride of sodium, chloride of ammonium, chloride of calcium, chloride of magnesium, or chloride of barium, or sulphate of soda, applied to a small quantity of clayey water, causes an immediate aggregation of the particles, and their complete precipitation shortly afterwards.

When the solutions are applied to a rather large proportion of clay water, the precipitation is not complete for several hours. The volume of clayey water clarified by one grain of certain of the above-named salts in 24 hours is approximately as follows—1 grain of common salt clarifies 5 ounces; 1 grain of chloride of barium or calcium, clarifies 10 ounces; 1 grain of sulphate of soda clarifies 5 ounces of clayey water; in addition to these it was found, 1 grain of lime clarifies 15 ounces, and 1 grain of sulphuric acid clarifies 50 ounces of clay water in the same time. Magnesia also when intermittently agitated with clay water has the same effects. Upon washing these clay precipitates repeatedly with pure water, the clay re-acquires its tendency of permanent diffusion. The quantity of clayey matters present appears of secondary importance, complete precipitation having nearer relation to the degree of dilution allowed to the salt employed. From these considerations, taken along with the fact of the existence of powerful affinities between the component parts of most of the substances here specified, it seems certain that these results of coagulation and precipitation are not due to their decomposition; the alternative is therefore, that they must thus act solely from their affinities for water; and if this is so, then from inference it would appear that the well-known quality of clay to remain in permanent suspension in rain or spring water in spite of its relative superior gravity is entirely due to the effect of a true chemical affinity existing between them; possessing in common with soluble bodies an insatiable quantitative affinity for water. Clay differs therefrom in the low intensity of this affinity (if I may use the term), a circumstance of course predicable from its insolubility; clay thus deports itself like certain other substances, which though soluble in pure water, are precipitated therefrom by others possessed of a superior affinity for the solvent,—for instance, ferrocyanide of iron by salts generally, silica in ammonia by chloride of ammonium, nitrate of baryta by nitric acid.

In conclusion I would desire to suggest that the transparency of the sea, into which is continually pouring such enormous quantities of turbid water, may be entirely due to the presence of so much saline matter.

ON THE PRECIPITATION OF COPPER BY HYPOPHOSPHOROUS ACID.

By WOLCOTT GIBBS, M.D.,
Rumford Professor in Harvard University.

In a memoir on the hypophosphites, A. Wurtz* has shown that when solutions of copper are heated to 70° C. with hypophosphorous acid, a hydruret of copper is precipitated, which on boiling is reduced to metallic copper with evolution of hydrogen. On repeating this experiment, I found that the precipitation of copper is complete, and as the alkaline hypophosphites are now to be had in commerce, it appeared probable that the process might be applied to quantitative estimation. Experiments to determine this point have been made by Mr. R. Chauvenet with the following results:—

The copper should be in solution as sulphate, the liquid containing a little free acid. The precipitation from the nitrate is always incomplete. When chlorhydric acid or chlorides are present the method fails entirely, the copper being reduced to subchloride and remaining in solution. The solution must not be too dilute; the precipitation is complete if the saturated solution of sulphate be diluted with not more than ten times its bulk of water, before the addition of the hypophosphites. In order to avoid the sudden evolution of hydrogen gas, and also to obtain the precipitate in a spongy coherent form, it is best not to allow the liquid to boil. The solution of hypophosphite having been added in the cold, and in excess, the temperature is to be gradually raised until, after standing for some minutes between 80° C. and 90° C., the hydruret of copper has entirely separated in coherent masses. It is easy to determine when the precipitation is complete, by taking out a drop of the clear liquid with a rod, and testing upon a porcelain plate with a drop of sulphydric acid solution. No filter need be used if the precipitation be effected in an assay flask; the copper is easily washed by decantation, and may then be transferred to a porcelain crucible by the well-known method of inversion, dried and gently ignited in a current of hydrogen. The following analyses will serve to illustrate the accuracy of this method. In all of them hypophosphite of magnesium was employed as the precipitant.

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* Ann. de Chimie et de Physique, 3rd series, vol. vi., p. 199.

	Gr. pure sulphate of copper.		Gr. of copper.		Per cent.	
1.	1·1650	gave	0·2965	=	25·45	(Chauvenet.)
2.	1·5590	,,	0·3970	=	25·45	,,
3.	1·4255	,,	0·3625	=	25·43	,,
4.	1·3050	,,	0·3327	=	25·42	(R.B.Carman)
5.	0·8208	,,	0·2087	=	25·42	(E. F. Gale)

In (4) and (5) a large excess of sulphate of nickel was present.

The formula $CuSO_4$ + 5aq. gives 25·42 per cent of copper. In the third analysis, sulphates of iron, manganese, nickel, and zinc, in very large excess, were added to the solution of copper.

I. In a very pure subsulphide of copper from Arizona, Mr. Chauvenet found, in four analyses, 74·24, 74·37, 74·36, and 74·41 per cent copper.

II. In an alloy of copper and nickel

	Gr.		Gr. of copper.		Per cent.	
6.	0·4245	gave	0.3605	=	84·92	(Chauvenet)
7.	0.3615	,,	0·3070	=	84·92	,,
8.	0·1380	,,	0·1170	=	84·85	,,
9.	0·1980	,,	0·1680	=	84·84	,,

III. In brass wire

	Gr.		Gr. of copper.		Per cent.	
10.	1·6300	gave	1·0705	=	65·67	(Chauvenet)
11.	1·8655	,,	1·2240	=	65·61	,,
12.	1·6770	,,	1·1010	=	65·65	,,

In the last seven analyses the alloy was dissolved in sulphuric acid, nitric acid being added from time to time to assist in solution. The solution was then evaporated until the last traces of nitric acid were expelled. The presence of iron in the form of sulphate does not in any way interfere with the complete precipitation of copper by hypophosphite of magnesium. When sesquichloride of iron is present, however, the copper is always reduced to subchloride, and is not precipitated as metal or hydruret. A solution of a hypophosphite reduces sesquichloride of iron to protochloride: the reduction is particularly rapid and complete when a salt of copper is also present and the liquid contains free chlorhydric acid. I have endeavoured to base upon this reduction a method for determining iron volumetrically, but all the experiments failed, in consequence of the difficulty of determining the exact point at which the reduction of the iron is complete. Sulphocyanide of potassium, proposed for this purpose by Winkler,† in his process, with subchloride of copper as a reducing agent, was not found to give sharp indications. When copper and iron are present together, as chlorides, the addition of hypophosphite of magnesium simply reduces the copper to subchloride, as above stated. If in this case we add an alkaline chloride to keep the subchloride of copper dissolved, the copper may be easily precipitated as subsulphide by sulphydric acid gas. When arsenic or antimony are present with copper, these must first be separated before precipitating the copper as hydruret, as careful experiments by Mr. C. Lilly have shown that both arsenic and antimony are precipitated with the copper. Mr. Lilly obtained the following analytical results when arsenious acid was present.

Gr. of sulphate of copper.		Gr. metallic copper.		Per cent copper.
1·2690	gave	0·3279	=	25·83
1·5127	,,	0·3905	=	25·77
0·9638	,,	0·2509	=	26·03

The formula gives 25·42 of metallic copper. In presence of antimonious acid—0·7100 gr. sulphate of copper gave 0·2454 gr. of copper = 34·56 per cent. After addition of Sb_2O_3 and Rochelle salt, 0·9875 gr. sulphate of copper gave 0·2426 gr. copper = 24·56 per cent. Repeated analyses by Mr. Lilly also showed that copper could not be determined accurately in Schweinfurt green by hypophosphite of magnesium, and that the presence of Rochelle salt did not completely prevent the precipitation of arsenic with the copper when arsenious or arsenic acid were mixed with sulphate of copper.

In assaying copper ores, it is usually desirable to bring the metal at once into the form of sulphate. Numerous experiments made in this laboratory fully justify me in recommending the following method:—The finely pulverised ore (sulphides of copper and iron) is to be mixed in a porcelain crucible with three or four times its weight of a mixture of 1 molecule of bisulphate and 1 of nitrate of potassium. The mixture is then to be slowly heated to low redness, which is best accomplished in a muffle. The metallic sulphides are completely oxidised without the least frothing of the heated mixture. Enough strong sulphuric acid to convert all the sulphate of potassium into bisulphate is then added, and the crucible is to be again carefully heated, until the contents run to a clear fused mass. On cooling the mass usually separates readily from the crucible, which is not attacked, and on solution the iron and copper are found completely converted into sulphates. This process has been tried successfully with a great variety of ores. The whole operation requires about an hour. In the case of ores containing much bisulphide of iron, it is best to heat the powdered ore first as long as sulphur is given off, and afterwards to add the oxidising mixture and heat as above. The sulphides of lead, zinc, and antimony are completely oxidised by the same process.—*Amer. Journ. of Science and Arts.*

COAL GAS
AS A POSSIBLE SOURCE OF CONTAMINATING
SUBSTANCES TO BE TESTED FOR AMMONIA.

In a paper on analysis of water, published at the latter end of last year in the *Scheikundige Bijdragen uit het Laboratorium van het Athenæum Illustre*, at Amsterdam, Dr. Gunning calls attention to the fact, that coal-gas however well purified is by no means free from ammonia; he felt induced to institute some experiments on this subject, the result of which is, that last summer the gas used in the Laboratory at Amsterdam contained 0·00075 gramme of ammonia, or ammoniacal substances in 1 litre of illuminating gas, amounts in bulk to a little over one cubic foot thereof in one thousand cubic feet of gas. Attention is called to the fact, that where wet gas meters are in use, the water of which is never replenished unless by some accident, this water must become pretty fairly saturated with ammonia; on emptying the water from one of the meters at the laboratory at Amsterdam its bulk was found to amount to 219 litres, *i.e.*, 48·66 gallons. 10 cubic centimeters of this fluid yielded 192 mlgrm. of ammonia, or bases of a similar nature. The whole quantity of water contained, therefore no less than 4·2 kilogs. of these bases; the meter had been in use for only two years. Since coal-gas, moreover, always contains sulphur compounds, there is formed sulphate of ammonia, which, on becoming converted by the intense heat into bisulphate of ammonia, attacks the glass cylinders, or chimneys, placed on the Argand gas burners. Dr. Gunning has found from expressly instituted experiments that no combustion of the ammonia takes place, not even in Bunsen burners, and mentions that a platinum basin filled with perfectly pure water, and placed for even less than an hour over a Bunsen burner, had got contaminated with a perceptible quantity of ammonia in the form of sulphate. There are two gas companies supplying Amsterdam, and there is a strong competition, but also a good surveillance to secure the gas to be as pure as possible. The experiment above alluded to was made with gas taken directly from the street main.

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† Zeitschrift für Analytische Chemie, Bd. iv., p. 423.

BLOW-PIPE COAL ASSAY.[*]

By BENJAMIN SMITH LYMAN.

Many young assayers are perhaps hardly aware how well adapted the blow-pipe apparatus is to the assaying of coal. Not only does the portableness of the apparatus make it very convenient for use away from home, wherever the scales can be set up; but its use at home is quite as satisfactory on the score of exactness as the assay with the muffle or retort, or large platinum crucible and large scales.

Besides the ordinary pieces of the blow-pipe apparatus, as made at Freiberg, all that needs to be made expressly for the coal assay is a small covered platinum crucible of the same size and shape as the clay crucibles of that apparatus; and there must be a little ring for the crucible to stand on, of German silver, about three-eighths of an inch across, and half that in height. Such a crucible cover and ring weigh about two grammes and a half more than the ordinary metallic cup that rests on the pan of the scales; the crucible and ring without the cover weigh less than two grammes more than the cup. If it be desired to determine the amount of hygroscopic moisture in the coal, a small drying bath must be made too; but W. R. Johnson's coal assays have shown that the hygroscopic water in ordinarily well dried coals (not brown coals) is of little importance.

The size of the crucible allows the cokeing of 200 to 600 or more milligrammes of coal, according to the dryness of the coal and the extent of its swelling up when heated; and as the blow-pipe scales (of Lingke's make) weigh within a tenth of a milligramme, it is easy to weigh within much less than a tenth of one per cent of the amount of coal assayed, much nearer, in fact, than the exactness of the coke assay in other respects. In this point, indeed, the blow-pipe assay is quite as good as the assay with the larger scales, especially the muffle assay, where the coal must be brushed into a clay receptacle after weighing, and the coke or ashes brushed off from it before weighing; while here the crucible is weighed each time without removal of its contents, and without danger, therefore, of losing anything or adding any dust. It may be objected that the smallness of the amount of coal that can be assayed with the blowpipe makes it a less trustworthy indicator of the general composition of the coal than a larger assay; but the size of the lumps or powder assayed may be made finer accordingly, so that when mixed up, an equally just sample of the whole mass would be got for the small assay as for the large.

Any one who has a little experience, both in the use of the blow-pipe and in the ordinary muffle assay of coal, would scarcely need any further teaching for the coal assay with the blow-pipe. For others, it is worth while to say that the coal may be assayed either in a fine powder or in little lumps, and either with a slowly increasing or with a quickly increasing heat. A quick heat will give less coke by several per cent, but will often make a dry coal cake together that would not cake with a slow heat. The cover of the crucible should be left open a little crack, for the easy escape of the gas, but covered enough to prevent any flying off of solid material. The heat should increase to redness, and as soon as the escaping gas stops burning the heat should be stopped. As some coals part with their gas more quickly than others, of course no definite time can be fixed for heating all coals; but the burning of the gas is a good enough sign. Care should be taken not to let the coke take up moisture from the air before weighing, as it will quickly do if it has a chance. Of course, owing to the different effect of quick or slow heat, a certain uniformity of result, even with perfectly uniform samples of coal, can only be got, without error, by practice and by mechanical skill, by reproducing with nicety the same conditions in successive assays.

After the coke has been weighed, it can be heated again with very free access of air, say, with the crucible tilted to one side, with the cover off, until everything is thoroughly burnt to ashes; and these should be re-heated until no change for the less is made in the weight. With free burning soft (semi-bituminous) coals this burning to ashes is very slow, so that it is very fatiguing or even impossible to carry it out with the blow-pipe; but in that case the crucible may be heated over a Bunsen gas-burner or an alcohol lamp, and left to glow for hour after hour. For the matter of that the coking is far more conveniently done in the same way than by blowing with the mouth.

Here is a pair of blow-pipe assays, made five years ago, of some West Virginia asphaltum, that seemed itself to be much more uniform in composition than coal from different benches in one bed is apt to be:—

	Volatile Matter.	Coke.	Ashes.
No: 1	47·29 per cent	52·71 per cent	1·65 per cent
No. 2	46·93 „	53·07 „	1·81 „
Mean	47·11 „	52·89 „	1·73 „

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[*] American Journal of Mining.

SWEET PRINCIPLE OF FROZEN POTATOES

By Dr. A. OTT.

At the meeting of the Polytechnic Branch of the American Institute, January 16th, Dr. Adolph Ott, well known as the author of a useful and interesting work on soap and candles, detailed the results of his recent investigations and experiments with potatoes, his object being to determine the sweet principle of frozen potatoes.

With a view to determine this question, he exposed 1 lb. of this vegetable to a very low temperature, and when thoroughly frozen, he first reduced a ¼ of a lb. of it to a pulp, by rasping, and expressed the sap, to 100 centimetres of which (33·8 fluid ounces) he added 10 cubic centimetres of basic acetate of lead; and this, filtered, and transferred to the glass tube of Mitscherlich's polarimeter, and placed between Nichols' prisms, gave no rotation of the plane of polarisation, thus establishing the fact that no sugar is present in raw, frozen potatoes. To decide whether sugar is formed in the process of cooking, he steamed 250 grm. (nearly 9 oz.) of the vegetable for one hour, and mashed them with 200 cubic centimetres of tepid water. The solution thus obtained was divided into two portions, from one of which was precipitated the gummy and protein matters with sub-acetate of lead, also discolouring the reddish brown liquid with a few drops of sulphuric acid. This, placed as before in the tube of the polarimeter, gave a change of colour, indicating the presence of uncrystallisable sugar. No calculation, however, was made from this, as the rotation of the grape sugar to the left is partly compensated by the dextrine and other substances; which are right-handed in respect to polarised light, and which are generally the product of heat upon albuminous starchy matter. He therefore had recourse to Fehling's test, by using the infusion of the boiled potato which had been set aside, by which the following elements were determined:—

1st. The percentage of sugar in the infusion.

2nd. The amount of water in the boiled potato.

Thus the percentage of sugar in the latter was calculated, and found to be 1·45 per cent. What, then, is the cause of the sweet principle? He would answer by saying that in freezing and thawing, the sap of the potato bursts the cells, and thus destroys vitality; at the same time, decomposition is setting in, which, though retarded by the cold, is not entirely arrested; the more so as, at the season most likely to freeze, and especially during a snow-storm, there abounds that powerful oxidising agent, ozone.

No doubt the outer portions of the starch grains are first attacked by it, and may thus be transformed into *diastase*, a body which, as we know, possesses the same power as dilute acids of converting a comparatively large quantity of starch, first into dextrine, and then into sugar, at a temperature of 140° to 170°, as in the process of cooking. Wheat contains enough diastase, as does every seed when sprouting, to convert all its starch into dextrine and sugar; not so with the potato, which, however, contains enough to form so much sugar as is necessary to give it that peculiar sweet taste.

The outer layers of the starch grains contain the albuminous bodies.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, Monday, March 30th.

Dr. Warren de la Rue, F.R.S., &c., President, in the Chair.

At this meeting there was a good attendance of members, and the officers of the Society were nearly all present.

The business of the evening commenced with the reading of the President's report, which gave a very satisfactory account of the past year's proceedings, but the obituary notices were, unfortunately, more numerous than usual. The list of members, in comparison with that of last year, stands thus:—

	1867.	1868.
Number of Fellows	499	510
Foreign Members	40	39
Associates	0	2

The number of papers read during the session amounted to forty-eight; and four lectures were delivered.

Five members have voluntarily retired during the year, viz.:—Dr. F. V. Paxton, and Messrs. Anselim Odling, C. N. Ellis, Edward Rea, and W. V. Russell. Eight names were struck off the list of members, by reason of arrears of subscription.

The losses by death included several distinguished Fellows, and one of the founders of the Society. They were Professor Michael Faraday, Dr. C. G. B. Daubeny, Dr. Thomas Clark, Dr. Wm. Herapath, Mr. Robert Warington, F.R.S., Messrs. J. Tennant, Walter Crum, W. H. Gossage, Alfred Noble, and Wm. Winsor, besides an eminent foreign member, Professor Jules Pelouze.

The President indicated some of the leading researches published during the year in the several departments of the science, and referred to the progress made towards establishing the new Chemical Theory. The investigations of Graham, Hofmann, Kolbe, Abel, Fittig, Frankland and Duppa, Perkin, and Pettenkoffer and Voigt were specially mentioned. The discussions upon water analysis had elicited facts which would ultimately prove useful in establishing a new method; and the review of geological phenomena, from a chemist's wide sphere of observation, could not fail to be productive of great results.

The Treasurer presented the balance-sheet for the year, which had been audited by Mr. Stephen Darby. The amount received from subscriptions was £540, and some of the disbursements were the following:—

Printing the Journal	£223
Proceedings of the Royal Society	50
Books and Magazines	43

The assets at the present time are a balance at the bankers of £637 1s. 11*d*., and £2347 18s. 10*d*. invested in Government consols. The outstanding subscriptions due to the Society are stated at £186 16*s*. 0*d*.

The election of officers was then proceeded with, Dr. Hugo Müller and Dr. T. Stevenson being appointed scrutators. The result was declared to be in accordance with the printed list, or that proposed by the retiring Council. The President was re-elected, and the names of the remaining officers are appended:—

Vice-Presidents, who have filled the office of President: Sir B. C. Brodie, F.R.S.; Thomas Graham, F.R.S.; A. W. Hofmann, LL.D., F.R.S.; W. A. Miller, M.D., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S.; A. W. Williamson, Ph.D., F.R.S.; Colonel Philip Yorke, F.R.S. *Vice-Presidents:* E. Frankland, Ph.D., F.R.S.; J. H. Gilbert, Ph.D., F.R.S.; J. H. Gladstone, Ph.D., F.R.S.; John Stenhouse, LL.D., F.R.S. *Secretaries:* William Odling, M.B., F.R.S.; A. Vernon Harcourt, M.A. *Foreign Secretary:* F. A. Abel, F.R.S. *Treasurer:* Theophilus Redwood, Ph.D. *Other Members of Council:* E. Atkinson, Ph.D.; F. Crace Calvert, F.R.S.; J. Lothian Bell; Dugald Campbell; W. Crookes, F.R.S.; David Forbes, F.R.S.; G. C. Foster; A. Matthiessen, Ph.D., F.R.S.; E. J. Mills, D.Sc.; H. M. Noad, Ph.D., F.R.S.; W. H. Perkin, F.R.S.; J. Williams.

Mr. E. T. Chapman moved a vote of thanks to the President for his services during the past year, which was seconded by Mr. Tennant, who took occasion to advise the printing in a separate form, and issue of duplicate copies to each member, of the annual report and address just now delivered by Dr. De la Rue. Such a course had been adopted with advantage in other learned Societies, and tended both to diffuse information respecting the aims of their body, and to do honour to the memory of the great chemists departed.

The vote of thanks was carried by acclamation.

Mr. Tennant's suggestion was afterwards made a substantive proposition, and warmly supported by Mr. Brayley; it was then put to the meeting, and carried unanimously.

Dr. De la Rue returned thanks, and in allusion to his wandering for a time from the paths of chemistry into the green fields of astronomy, humorously illustrated the feeling of amazement which overcame him on returning to a chemical career, by comparing his experience to the dream of Rip Van Winkle.

A vote of thanks to the retiring members of Council and a special acknowledgement of Mr. Watts's services, were moved and carried with acclamation. The meeting was then adjourned until the 2nd of April, the papers to be then read having already been announced.

FOREIGN SCIENCE.

Paris, March 31, 1868.

Method of estimating the proximate constituents of meteoric iron.—On the corresponding term to benzoic acid in the naphthalic series.—Determination of the equivalent of aluminium.

Reference has already been made to the researches of M. Meunier, on meteoric iron, in one of my former letters; the same investigator has, more recently, proposed a general method for the proximate analysis of meteoric irons. According to his experiments, iron of meteoric origin is composed of mixtures of iron and nickel, carbide of iron, sulphide of iron, phosphide of iron, and graphite. Certain species of minerals are never found intermingled, wherefore it is often unnecessary to consider the separation of some of the usual constituents. Frequently the carbide of iron disappears, or does not exist in estimable amount; such, for example, is the case in the meteoric iron discovered in 1784 at Xiquipilco, in the Valley of Toluca, Mexico. M. Meunier examined the various components given above separately. Nickeliferous iron obtained from various specimens of meteoric iron, differed considerably in composition, but the properties were sufficiently analogous to allow of its being considered as a single substance in the processes of separation. The substance is soluble in most acids, yielding a nickel salt and an iron salt; sometimes, although rarely, the solution is accompanied by the deposit of a little carbon: cold fuming nitric acid is without solvent action on it. Solutions of potash and soda, even at ebullition, are without action. Fused caustic alkalies do not dissolve, to any sensible extent, the nickel-iron mixtures. Sometimes nickeliferous iron does not precipitate salts of copper, such as nitrate and sulphate, in the cold, but upon heating to ebullition, the precipitation is always effected. Chlorine attacks nickeliferous iron pretty rapidly, especially in the presence of water; bromine and iodine exert a similar but less powerful action. Carbide of iron partakes, for the most part, of the properties of nickeliferous iron. The sulphide of iron, termed *troilite*, dissolves in hydrochloric acid with disengagement of sulphuretted hydrogen; fuming nitric acid has no action upon it; concentrated solution of sulphate of copper is not decomposed, even upon boiling, by troilite; alkaline solutions are almost without action in the cold, but they exert action, though sluggishly, upon boiling; the fused alkalies dissolve it instantaneously. The name of phosphide of iron M. Meunier gives provisionally to the compound better known as *schreibersite*, and which exists in most metallic meteorites. The composition of the mineral has not yet been defined; at the same time, the existence of phosphorus, iron, and nickel, is recognised. Magnesium possibly enters into the composition of schreibersite also. The mineral is not acted upon by boiling hydrochloric acid; alkaline solutions only attack it when aided by heat; fused potash and soda dissolve it instantly; *graphite* resists the majority of reagents.

By means of the various reactions indicated above, M. Meunier was enabled to separate the iron of Toluca into its four proximate constituents. The analytical process is conducted as follows:—(1.) Estimation of the nickeliferous iron—1 gramme of iron-filings, obtained by means of a very hard file, is projected into some grammes of pure potash in tranquil fusion, contained in a silver crucible. Care must be taken to throw the metal quite into the middle of the fused mass, and not on to the sides of the crucible, where it would undergo oxidation. Schreibersite and troilite are decomposed, and nickeliferous iron and graphite alone remain in the solid state. After cooling the fused mass is placed in strong alcohol, and allowed to remain there for about forty-eight hours. At the end of this time the whole of the potash is dissolved, and the lixivium, at the bottom of which the mixture of graphite and iron is found, is filled with brown flocks of oxide of iron. Decantation easily removes the light oxide; the residue is well washed with alcohol, and then dried. This residue is then treated with slightly warm fuming nitric acid: all the graphite disappears. It is only necessary to wash the nickeliferous iron, and dry. M. Meunier obtained about 96 per cent of nickeliferous iron.

(2.) Estimation of the graphite.—3 grammes of iron-filings are projected, as before, into fused potash, and a mixture of graphite and nickeliferous iron obtained. This mixture is treated with hydrochloric acid, which dissolves the iron and leaves the graphite. The graphite might contain a little carbon resulting from the decomposition of carbide of iron, but carbon due to this source can always be estimated. Another method of separating the iron and graphite would be lixiviation. It is, however, indispensable that the physical separation be controlled, to some extent, by a chemical process. The Toluca iron gave 1·176 per cent graphite.

(3.) Estimation of the troilite.—To estimate this, 3 grammes of filings are boiled for about a quarter of an hour with a solution of oxide of copper. All the nickeliferous iron is dissolved, and by decanting and washing, a residue is obtained, composed of troilite, schreibersite, graphite, and metallic copper. This mixture is treated with fuming nitric acid; the copper and graphite are removed, and troilite and schreibersite are thus obtained in a state of purity. No reaction has been discovered permitting the isolation of the troilite; it is therefore necessary to have recourse to lixiviation, and to separate the schreibersite and troilite by their different specific gravities. The specific gravity of troilite is never more than 4·7, while that of schreibersite is 7·01 to 7·22. Toluca iron gave by the process described 1·482 per cent of troilite.

Estimation of the schreibersite.—The preceding operation evidently gives a first determation of the schreibersite, in the lixiviation. The number thus found can be controlled by a chemical process. Having obtained the mixture of schreibersite and troilite, treatment with hydrochloric acid will dissolve all the sulphide, leaving consequently the phosphide in a state of purity. Toluca iron gave 1·232 per cent of schreibersite. The numbers found for each of the proximate constituents added together will be found to give 100·191.

The following is an abstract of Dr. Hofmann's communication to the Academy on the corresponding term to benzoic acid in the naphthalic series. When a mixture of four parts of naphthaline of commerce, and five parts of crystallised oxalic acid is submitted to distillation in an iron pot, the cover of which is furnished with a tube (the kind of vessel used in the manufacture of cyanide of potassium), water and naphthaline come over at the commencement; soon also, an oily substance which is not slow to solidify makes its appearance. This oily substance is composed of naphthylformamide, naphthyloxamide, oxalate of naphthylamine, naphthylamine, and water. A current of steam removes from the oily product notable quantities of an opaque brown oil, having a greater density than that of water. The analysis of this body leads M. Hofmann to call it cyanide of naphthyl, and proves to him that the succession of transformations undergone by naphthylamine when acted upon by oxalic acid is quite analogous to that already shown in the case of aniline and toluidine. The purification of the crude mixture presents no difficulty. Solution of the oil in ether excludes the water; the etherial liquid is evaporated, and the residue distilled. It is only at 218° or 220° that the thermometer becomes stationary; the portion distilling at this temperature soon solidifies. This portion is shown by many properties to be naphthaline, mixed with a small quantity of a substance possessing a peculiar aromatic odour, and boiling at a higher temperature. The point of ebullition soon rises to 290° and 300°; the remainder of the liquid distils in the form of a clear yellow liquid, which becomes a white crystalline mass when left a considerable time in a cold place, or when immersed in a freezing mixture. Once solidified it does not become fluid again at the ordinary temperature. Crystallisation from alcohol will render the body pure. The alcoholic solution mixed with water deposits the oil again. The crystals melt at 33·5°; and the substance boils at 290°. This new crystalline compound corresponds in the naphthalic series to the benzonitrile of the benzoic series. The formula is $C_{11}H_7N$. For this body to be placed among the nitriles, it ought under the action of powerful metallic hydrates, to fix a molecule of water becoming an amide, which by absorbing another molecule of water should give rise to a salt of ammonia: experiments upon these points have confirmed its position. If the nitrile is dissolved in alcoholic soda, only traces of ammonia are disengaged, but upon adding water one recognises the formation of a new compound.

The crystals deposited are little soluble in alcohol, and only melted with difficulty. Purified by repeated crystallisations from boiling alcohol, the compound presents itself in the form of white needles. Analysis has given the formula $C_{11}H_9NO$. The product is thus derived from the nitrile by the assimilation of a molecule of water, and is the amide. In making this last substance, by the action of soda, ammonia is evolved. It is only necessary to add hydrochloric acid to the alkaline solution to precipitate a crystalline acid resembling in its properties, vividly, benzoic acid. This precipitate can be obtained quite as readily from the crude nitrile, by treating the latter with an alcoholic solution of soda until ammonia ceases to be evolved, evaporating the alcohol, and decomposing the alkaline liquid by hydrochloric acid. The acid is purified by crystallising from alcohol, or better from boiling-water. The pure acid crystallises in white needles, which melt at 160°. At a higher temperature the acid sublimes; its boiling point is 300°. The acid has scarcely any odour or taste; gently heated, it exhales an odour analogous to that of naphthaline: the vapours excite coughing. Solutions of the substance possess a slightly acid reaction; they decompose alkaline carbonates with facility. M. Hofmann proposes the names menapthoxylic acid and naphthaline-carboxylic—the amide and nitrile would then be menaphthoxyl-amide and menaphthenylnitrile. Several salts of the acid have been made; the composition of the silver salt is represented by the formula $C_{11}H_7AgO_2$. The copper salt is a green precipitate, the lead salt white. When the acid is distilled with caustic baryta, naphthaline and carbonic acid are obtained—$C_{11}H_8O_2 = C_{10}H_8 + CO_2$. li 4 parts of fused menaphthoxylic acid are ground with 5 parts of perchloride of phosphorus, the two bodies act upon each other at once. The mixture is liquefied at the ordinary temperature; heated moderately, hydrochloric acid and oxychloride of phosphorus are produced. The boiling point rapidly rises to 300°; the fraction distilling between 296° and 298° is pure menaphthoxylic chloride. Its composition is $C_{11}H_7OCl$; it comports itself like most chlorides of the aromatic acids. Exposed to the air, it absorbs moisture, and is gradually transformed into menaphthoxylic acid; addition of water causes the reaction to take place instantaneously. Treated with ammonia, the chloride furnishes menaphthoxylamide, possessing all the properties of the body obtained by the action of an alcoholic solution of potash on the nitrile. When the chloride is placed in contact with an alcoholic solution of aniline, a white crystalline mass results. This compound is $C_{17}H_{13}NO$. The solution of aniline, replaced by naphthylamine, yields a compound of the formula $C_{21}H_{15}NO$. In treating the chloride with absolute alcohol, a compound of the formula $C_{13}H_{12}O_2$ is obtained.

M. Isnard addressed a note on the determination of the equivalent of aluminium. The process employed consisted in attacking the metal by hydrochloric acid. He found that 9 grammes of aluminium attacked by pure hydrochloric acid gave invariably, after calcination, 17 grm. of alumina, whence he concludes that 9 should represent the equivalent of aluminium, hydrogen being unity.

Solubility of Amorphous Silica in Ammonia.—Silica which has been liberated in a hydrous form, when allowed contact with a cold aqueous solution of ammonia for a short time, is sensibly dissolved, as therein demonstrated by the gelatinous precipitate the solution affords to chloride of ammonium, insoluble in cold solution of potash. When the silica is reduced to the anhydrous state, even by strong ignition, it is still partly soluble in ammonia. If for the last experiment a glass vessel is used which has just previously been in contact with hydrochloric acid, it is necessary to allow it contact with ammonia or caustic alkali for some time, for the purpose of removing the silica thereby liberated on the surface of the glass.—W. Skey.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Neurin and Sincalin.—Claus and Keesé have made some experiments on sincalin with a view of elucidating the nature of its relation to neurin. After a careful comparison of the various derivatives of the two, particularly of the chloro-platinate and aurate, the authors come to the conclusion that they are identical.—(*Journ. pr. Chem.* cii. 24.)

Naphthalene.—H. Vohl. Perfectly pure naphthalene has the specific gravity at 19° C. = 1·15173; it fuses at 79°·25, and boils at 217° to 218°. The fused material absorbs large quantities of air,—that is to say, a mixture of nitrogen and oxygen containing nearly 50 per cent of oxygen,—which escapes again on cooling just before solidification takes place. Fused or boiling naphthalene is a powerful solvent and medium for crystallisation for a variety of substances, as sulphur, phosphorus, sulphides, iodine, indigo, &c. As regards the detection of naphthalene the author makes use of the following reaction; to naphthalene is added nitric monohydrate, the mixture diluted with much water, the precipitate washed with water, finally with diluted alcohol (1 alcohol of 90 per cent, 3 water), the residue mixed with a few drops of aqueous potassic hydrate and sulphide, and evaporated to dryness; this residue on addition of alcohol gives a brilliant violet tincture.—(*Ibid.* cii. 29.)

Double Chloride of Thallium and Iron.—Wöhler. When freshly precipitated and still moist thallic chloride is added to a concentrated solution of ferric chloride containing much strong chlorhydric acid in excess, a red precipitate is formed, the composition of which is $3TlCl + Fe_2Cl_3$. Another way for preparing this compound consists in fusing thallic chloride in the vapour of ferric chloride. The double chloride dissolves in hot strong chlorhydric acid, and separates on cooling in red prismatic crystals. Water decomposes it immediately, throwing down white thallic chloride.—(*Am. Chem. Pharm.* cxliv. 250.)

Cerium.—Wöhler. On fusing the chlorides of the cerite metals with sodium, globules of reduced metal are obtained which seem to consist principally of cerium; the colour of the metal is between that of iron and lead, and it is nearly as soft as lead; its specific gravity is about 5·5. If a globule is heated suddenly to a high temperature in a blow-pipe flame combustion takes place, accompanied with an explosion, and sparks of most intense luminosity are thrown out. From the portion of the flux in which the metal is found imbedded, a glittering dark purple crystalline powder may be isolated by digestion with water; this compound is an oxychloride of cerium, its composition being represented by the formula, $CeCl + 2\ CeO$.—(*Ibid.* cxliv. 251.)

Determination of Ammonia.—O. Meister shows that ammonia or its salts when in a greatly diluted state, as in waters for example, may be successfully determined by evaporating one or two litres of the solution in question with the addition of about 5 grammes of sulphuric acid, and distilling the residue with a solution of sodic hydrate, previously boiled, into sulphuric or chlorhydric acid of known strength.—(*Naturf. Gesellsch. Zurich*, 1867, 172.)

Distillation.—P. Pellogio describes a contrivance by means of which the troublesome "bumping" peculiar to certain liquids when under distillation may be entirely prevented. It consists of a glass tube as wide as practicable, inserted through the tubulus, and reaching nearly to the bottom of the retort, and having the upper end bent at a right angle, and drawn out to nearly capillary dimensions, thus establishing a communication between the outer air and the interior of the retort. With the help of this arrangement such liquids as methylic alcohol, sulphuric acid, petroleum residues, &c., distil as smoothly as alcohol or water.—(*Zeitschr. Analyt. Chem.* vi. 396.)

Acrolein.—A. Claus. If a solution of potassic hydrate, alcoholic or aqueous, is saturated with acrolein, and sulphuric acid be added, a precipitate of hexacrolic acid is obtained, and from the mother liquor acrylic acid may be distilled off.—(*Naturf. Gesellsch. Freib.* i. Br. 1867.)

Oxidation of Amylic Alcohol.—A. Claus. In a cylinder were placed, without mixing, nitric acid (specific gravity 1·5), water, and amylic alcohol. After about four months the smell of the alcohol had disappeared, that of amylic valerianate having taken its place. The mixture was then diluted with water and half of it distilled off; the distillate consisted chiefly of the ether, and the residue on further concentration gave off much nitric acid vapour, and on cooling separated crystals of oxalic acid.—(*Ibid.* 1867.)

CORRESPONDENCE.

PRESERVATION OF MEAT.

To the Editor of the Chemical News.

Sir,—Having worked in conjunction with Prof. Gamgee at the development of the meat preserving process, I can answer for him the inquiries of your correspondent. The sheep sent over from England were preserved in substantially the same way as the meat mentioned in the Chemical News, vol. xv., p. 135, viz., by treatment with carbonic oxide and sulphurous acid. The carcases were whole, and merely packed in wooden boxes containing soft material to prevent bruising. The details of the process are of course given in the English, United States, and other patent specifications, to which I must refer all seeking information,—I am, &c.,

Walter Noel Hartley.

March 30, 1868.

ROYAL SCHOOL OF MINES.

To the Editor of the Chemical News.

Sir,—In his last letter, "A. L. E." proposes, *en passant*, a change in the curriculum of this School, to which, it appears to me, much greater prominence is due. I refer to the passage in which he mentions the desirability of increasing the present staff of professors by two, viz., on botany and mathematics.

When the late Professor Forbes was alive, the lectures of general natural history were rightly named, inasmuch as they included both zoology and botany; but Professor Huxley, his successor, does not include botany in his course. Now, I suppose none would blame the Council for preferring such a man as Professor Huxley to another of inferior talents who would include both subjects; and had the Council supplemented their election of Professor Huxley to the chair of zoology by another election to the botanical chair, all would have been satisfied. As it is, however, the whole of the botany taught in this School is limited to the lectures on palæontology, where it is, *ex necessitate*, only briefly treated.

Such a step would be a boon, not only to the students of this school (for then I should have little excuse for thus trespassing on your columns), but to the whole mass of London students. For as the present course on zoology, yearly delivered by Professor Huxley, is unequalled, I think I may with safety say, in the British Islands, so, I suppose, would it be the case with the botanical lectures. The difficulty of obtaining, at the present time, any course of lectures on this subject, which goes into the science at all deeply, is too well known to those who have tried to find such lectures, to need comment from me.

I find that the length of my letter forbids me entering into detail on the subject of the mathematical course; I therefore leave it, and with less regret, since the relations of mathematics to physics and mechanics are so very apparent.

I will not waste your space by apologies for trespassing thereon; and thanking "A. L. E." for raising the discussion, and yourselves for so kindly opening your columns thereto,—I am, &c.,

An Exhibitioner, R.S.M.

THE PERMANGANATE WATER-TEST.

To the Editor of the Chemical News.

Sir,—Will you permit me to make a few observations on the paper which appeared in your number of the 27th of March, on the nature and examination of the organic matter in potable waters? It is from the sanitary point of view that I propose to consider the subject, because, as was remarked by the author of that paper, it is the fitness or unfitness of water for drinking purposes, and the quality and effects on the health of the organic matter contained in water, rather than its quantity, which are the points that give importance to the subject.

Some seventeen years ago Professor Forchhammer, of Copenhagen, proposed to estimate the quantity of soluble organic matter in water by permanganate of potash. After a considerable lapse of time his proposal was extensively adopted and relied upon by some chemists, as a means of volumetrically determining the amount of organic impurities present in water. Subsequent observations have, however, demonstrated that for the purpose of estimating the quantity of organic matter contained in water, permanganate of potash cannot be relied upon.

In the meantime (some twelve years ago) Mr. Condy, of Battersea, having discovered the disinfecting properties of the alkaline permanganates, proposed to apply his solution of those salts (Condy's Fluid) to the determination of the quality of the soluble organic impurities of potable waters, and succeeded in satisfactorily demonstrating that his method was not only a quick and ready, but likewise a reliable sanitary test for soluble organic matter in water. Having been adopted in several of the public services, and used extensively among medical men during a period of many years, his process must be considered firmly established. I could myself detail many striking proofs of the sanitary value of this test which have come under my notice in the course of my experience as a lecturer on hygienic subjects at various institutions throughout Great Britain, but will confine myself to a recent instance. Having been supplied, through the kindness of Dr. Gimson, with specimens of water from all the wells of Terling, I easily detected the infected waters by this test alone, and on handing him my results they were found to be exactly borne out by his experience of the course taken by the serious epidemic of typhoid fever which has been prevalent there during the last three or four months.

While, therefore, permanganate of potash has been found comparatively worthless for estimating the quantity of organic matter in water, its value as a quick and ready sanitary test for the quality of the organic impurities of potable waters has been placed beyond doubt.

It would, consequently, seem to me that the way in which the question of the utility of the permanganate test has been dismissed, in the paper under consideration, is calculated to propagate error and to discredit one most useful and reliable application of it, for showing inadequate reason that another and totally different application has proved to be faulty and comparatively worthless.

The study of the effects of permanganate on organic matter shows that, as a rule, it acts with great rapidity on such matter when in a putrescent or offensive state, but slowly on sound or harmless organic substances. Thus its complete action upon water mixed with pure organic matter would be a matter of days; whereas, on the other hand, if the sample be allowed to stand till decomposition sets in, the permanganate would act with great rapidity on the decomposed portion. Dr. Angus Smith, in a pamphlet on this subject privately printed and circulated (but not published, so far as I am aware), says: "The organic matter which decomposes the chameleon in a minute or two, must be carefully noted; but generally there is a greater quantity which decomposes very slowly: the result obtained for the latter is, I believe, of less value. Generally considerable permanency is obtained in ten or fifteen minutes; then the slow decomposition begins of quite another quantity of organic matter, requiring hours or even days. The amount decomposed instantly is a true measure of the putridity." It is a most important matter, therefore, in considering the action of permanganate on water, to keep clearly in view these several actions which actually give the real practical value to that substance as a test for, and destroyer of, dangerous organic matter. It affords the most rapid and ready mode of detecting the offensive and dangerous substances, while it leaves the inoffensive and harmless matters comparatively untouched. It is evident that when a speedy test for the existence in water of impurities to which the origin of disease in a household may be due, a reagent is not wanted which would expend its chemical force on such harmless matters as sugar, gum, starch, and the like, but one which can seek out and reveal offensive organic substances, which, in the words of the paper in question, are often of "such deleterious nature, that our ideas of the most virulent matter fall short of the horrible results that these invisible poisons can accomplish."

By turning to the Chemical News of the 7th of February last, it will be seen that, at a meeting of the Manchester Literary and Philosophical Society, Dr. Angus Smith confirmed his above-stated views, by declaring that "the condition of organic matter in water can be estimated for sanitary purposes sufficiently by permanganate of potash," which is precisely the proposition first advanced by Mr. Condy ten years ago.

Some little time since Professor Attfield published, through the medium of the *Times*, a somewhat ingenious extemporary method of recognising pollution in water, by means of the sense of smell. But the time required by this method is sometimes so great, and the nose, especially among persons who have not been used to discriminate faint odours by the olfactory organ, is so inferior to the eye, that were it even more accurate and reliable than it is, Professor Attfield's test, though well worth knowing as an excellent make-shift in certain exceptional cases, may be set aside as having nothing to recommend it for ordinary occasions.—I am, &c.,

John Muter.
Author of "The Alkaline Permanganates and their Medicinal Uses."

Richmond Terrace, March 30th, 1868.

DETECTION OF ADULTERATED FLOUR.

To the Editor of the Chemical News.

Sir,—Your querist, "Q.," asks for a method of detecting the adulteration of wheaten flour with the flour of the seeds of the leguminosæ, *i.e.*, beans, lentils, peas, &c., other than the detection of the difference of the starch globules of the latter meals by means of the microscope. The wheaten flour suspected to be thus adulterated is made into a paste with water, the paste is placed in a clean linen cloth and is kneaded under a constant stream of fresh water, until the water runs off quite limpid; in other words, all the starch and matters soluble in water are washed out, and the gluten is retained in the cloth. The following points deserve to be noticed:—

(*a*) Whether the paste does not emit a peculiar smell not met with in paste made with unadulterated flour.

(*b*) Whether it exhibits a peculiar fatty appearance.

(*c*) Whether the water does not exhibit a soapy appearance.

(*d*) Whether the gluten which remains on the cloth exhibits the proper degree of toughness and elasticity, so characteristic of the gluten from pure, sound, wheaten flour.

The water which has served for washing, is collected, and after having been well and vigorously stirred up, is divided into two equal portions. One of these is left standing exposed to a temperature of from 70° to 86° F., in order to try whether foul fermentation does not set in; this does *not* take place at all, in case the flour under examination, and treated as described, were sound wheaten flour, since in that case only lactic acid is formed under the conditions just alluded to; the other portion of the water is first diluted with some distilled water, rendered alkaline by the addition of some liquid ammonia. The fluid is then left quietly standing, until all the starch has settled down, is next filtered, is then submitted to evaporation on a water-bath, until a kind of pellicle, or skin, is observed to be formed on its surface; it is then cooled down, filtered, in order to separate coagulated albumen, while to the clear filtrate next acetic acid, in slight excess, is added. If the addition of this acid causes a precipitate, it is possible that such might be due to the presence of legumin, owing to the adulteration of the wheaten flour by means of the ground-up seeds of leguminosæ; but since the precipitate might be due to immixtures in the wheaten flour of buck-wheat meal, colza-cake meal, indian-corn meal, or even accidental presence of chloride of sodium, it is requisite to collect the precipitate on a filter, to wash it with warm distilled water, and to submit it to the following tests:—

(*a*) To observe whether it is colourless, and devoid of smell and taste.

(*b*) Whether on drying it becomes horny, hard, and translucent.

(*c*) Whether it is tinged blue by iodine.

(*d*) Whether it is, or is *not*, soluble in hot or cold water.

(*e*) Also, insoluble in alcohol (pure alcohol, not methylated spirit).

(*f*) Soluble in a weak solution of caustic potassa in ammonia, and precipitable therefrom by means of hydrochloric, nitric, and acetic acids, all of which reactions refer to legumin.

The precipitate or sediment of the washings of the flour under examination is next divided into two portions; the smaller of the two portions is again divided into two parts, and to one of these is added a solution of caustic potassa, containing 10 per cent solid alkali, while to the other is added some dilute hydrochloric acid; in both instances the starch is by these means dissolved, and if some of the fluid is placed, under proper conditions, under a microscope with a magnifying power of 300, there will, in case any meal of peas, beans, lentils had been present, be seen the remnants of the broken-up cellular tissue peculiar to these seeds, and exhibiting a peculiar net-like texture. The larger portion of the sediment may be carefully washed out with water, so as to obtain six different wash-waters, all depositing sediments of starch, the last, or sixth of which will contain the peculiar starch of the seeds just alluded to. Fresenius has called attention to a peculiar difference in the ash of the wheaten meal, or flour suspected to be adulterated with leguminosæ seeds. Such ash is—1st. deliquescent; 2nd, its aqueous solution tinges turmeric paper brown; 3rd, there will appear, on addition of nitrate of silver solution to such ash, a precipitate of chloride of silver which, on exposure to daylight, becomes discoloured. Pure and sound wheaten flour does not contain any chlorides at all, and though the solution of its ash yields a precipitate with nitrate of silver, that precipitate remains unchanged by exposure to daylight. Reddened litmus paper is rendered blue when brought into contact with the solution of the ash of pure, sound wheaten flour, but turmeric paper remains unchanged. Louyet further observes that the quantity, also, of the ash may serve as a criterion; dried old wheaten flour only yields 1 per cent of ash, rye meal about the same; but the meal of peas and beans yields never less than 3 per cent; the addition therefore of even 10 per cent, by weight, of meal of peas or beans to wheaten flour will sensibly alter the quantity of ash the latter ought to leave behind on incineration executed with proper care.

It may therefore be assumed that, if wheaten flour yields more than one, but below two per cent of ash, it is adulterated with meal of peas, &c., since an intentional adulteration with metallic or earthy matters will almost always be so carried out as to bring the ash far above 1 per cent.

Donny states that if wheaten flour is adulterated with the meal of white beans (haricot beans), or with that of lentils, provided, however, the quantity thereof be not below 5 per cent, and such meal is so placed in a deep porcelain basin as to cover with a slight thin layer the sides of such vessel, while the bottom is left uncovered, that then when first a few drops of strong nitric acid are allowed to evaporate from the bottom, and immediately after some ammonia, reddish specks will make their appearance in the flour along the sides of the vessel, which red specks indicate the presence of the meal of these two substances. A better test is to exhaust the suspected flour with pure warm alcohol, to evaporate the latter, to treat the alcoholic extract with ether, and to expose the residue thereof, while air has free access to the vapours first of nitric acid next of ammonia, the residue will, if either the meal of white beans or lentils had been present exhibit a beautiful amaranth pink colouration,—I am, &c.,

Dr. A. Adriani.

MISCELLANEOUS.

Select Committee on Scientific Education.—In the House of Commons on Friday last on the motion of Mr. Samuelson it was agreed that the Select Committee on Scientific Instruction do consist of 18 members:—Mr. Acland, Mr. Akroyd, Mr. Bagnall, Mr. Bazley, Mr. Henry Austin Bruce, Mr. Berecroft, Lord Frederic Cavendish, Mr. Dixon, Mr. Graves, Mr. Gregory, Mr. Thomas Hughes, Sir Charles Lanyon, Mr. M'Lagan, Lord Robert Montagu, Mr. Edmund Potter, Mr. Powell, Mr. Read, and Mr. Samuelson.—*Times*.

Modern Physical Science.—The following forms the conclusion to a course of lectures on "Heat," recently delivered at Eton College by Mr. G. F. Rodwell. "I have said much in the foregoing lectures concerning the motions possible to particles of matter, because I have wished to impress upon you the fact that physical science is daily becoming more and more a science of kinetics,—a science which resolves the direct acting causes of phenomena into motions of particles, variety of form being induced by variety of motion. We have done with imponderable fluids, their media, subtle essences, and with all the meaningless terms which have from time to time been proposed to designate the so-called Physical Forces. We now regard them as attributes of matter, inseparable from matter; as actions possible to small particles, whether they be extremely extended as in the ether which pervades space, or comparatively close together as in the metals. Forces differ from each other either because the velocity of the motion which constitutes them varies, or because the motions themselves differ in form. All matter possesses motion. We have seen that if we increase one kind of motion to a certain extent the substance possessing it becomes what we call hot, while if that motion be further increased light appears; hence the inference that the motion called light is an intensified form of the motion called heat, that is that the difference is one of velocity, not of form or character. Again we have seen that the motion of heat interferes with the propagation of the motion called electricity; hence the inference that the one motion differs in form and character from the other, and not simply (as in the case of heat and light) in velocity unaccompanied by change of form. We can readily comprehend this if we bear in mind that the particles of a mass of matter moving with a certain kind of motion, cannot so readily assimilate a motion of a different kind as if they were at rest at the time of its inception, or as if the new motion were similar in form, and differed only in velocity. In the study of physical science we must apply that which we know of the movements of visible masses of matter to the movements of unseen particles: we must construe occult and invisible actions by the aid of visible and known actions; it is thus alone that we can form any ideas of the nature of the motions which appertain to the small particles of matter. This is the basis of a true kinetic system. In connection with the formation of such a system I am constrained to mention one who is too little recognised in the present day. A man who possessing illimitable capability and almost universal knowledge had yet learned to guide his intellect by recognised laws of thought: to make it accurate, and subtle, and profound, and infinitely calm in its immensity. A man habituated to intense meditation, to exact mathematical reasoning, to a careful observation of nature. Lucid in his mode of thought, sound in his judgment, he was actuated by a pure love of truth, by a desire to produce a legitimate familiarity between mind and matter, by a grand admiration amounting almost to reverence for the wonders wrought in the Universe. I speak of René Descartes, the founder of the first comprehensive kinetic system; the founder of a physical philosophy which is the ancestor of that into which we are now merging. Our recent physical philosophy may almost be called neo-Cartesianism. In conclusion, I will ask you to bear in mind, that although the forces of Nature undergo perpetual transformation, there is in all cases an equivalence of transformation. We know that if we have a mass of matter, A, moving with a definite velocity, we can so dispose this action that it may appear in a mass, B, as motion of another kind, but of precisely equal value; we know also that if a mass moves with a certain velocity, the sum of its action may be truly represented by a smaller mass moving with a greater velocity, or by a larger mass moving with a less velocity. It is thus with the forces of Nature: a definite amount of a force, A, if it be transmuted into a force, B, appears in one definite amount truly representing A, and competent to assume the form of A; or let a force, A, be transmuted into other forces, B, C, D, and although A has assumed so many different actions, the totality of its action still prevails,—the diverse forms are capable of being re-transmuted into the original form. A latent force is like a compressed spring, it is in a condition of potentiality. Whether a force be acting or at rest it represents the same amount of action it differs only in this, that while it acts it yields up its individuality of form, whereas while it is at rest it maintains its individuality of form. The forces which produce the phenomena of the Universe move in a circle which is never broken. There is an eternal round of change. A force altered in form, and apparently caused to disappear in inducing natural phenomena becomes force of another kind, sometimes actual, sometimes potential. The phenomena of the Universe are the measures of transformed force."

Torpedo Experiments.—A short time ago, a trial was made on board H.M.S. *Lightning*, at Pembroke, in the presence of some of the members of the Floating Obstruction Committee, of Captain Harvey's new sea torpedo, which gave great satisfaction. As a distinct private experiment, a small torpedo, charged with 20 lbs. of a highly explosive agent (equal to about 100 lbs. of gunpowder), the invention of Mr. Horsley, scientific chemist, of Cheltenham, but formerly of Portsmouth, was brought in contact with a vessel, which was instantly and totally destroyed with a grand effect, the report of the explosion being heard for miles round Pembroke. There is no doubt about its being one of the most destructive engines of war yet invented, and will make short work of an enemy. —*Hants Telegraph and Sussex Chronicle.*

Applying Charcoal to Sewer Ventilators.—In a recent number we gave an abstract of the report to the Metropolitan Board of Works "On the Ventilation of Sewers," by Dr. Miller. Our attention has since been called to the fact that so early as 1862, the proposal of Dr. Miller had already been successfully carried out in the City of London by Dr. Letheby and Mr. Haywood. The district experimented upon was in the Eastern portion of the City of London, comprising a space of about fifty-nine acres, with about 1,700 houses, and about 14,000 inhabitants. Wood charcoal was employed, broken into pieces of the size of a filbert. It was packed closely, but without compression, upon the various trays; and each tray held about $1\frac{1}{12}$ lbs. of charcoal, making altogether 6½ lbs., distributed over the six trays of each air filter. The experiment was commenced on the 14th of July, 1860, and continued for a period of rather more than eighteen months. The general conclusions from these experiments, and from the consideration of collateral evidence are:—that dry charcoal in the presence of atmospheric air is a powerful means of destroying the mephitic gases and vapours of sewers and house drains; that the charcoal filters may be used with efficacy in the course of the air channels from the drains and closets of houses, as well as in the ventilation of the public sewers; that in applying the charcoal, those contrivances should be used which offer the least resistance to the free passage of the air; that the situation of the filters is best, when the charcoal is protected from wet and from dirt, and is easily accessible; that from the ascertained efficacy of charcoal in destroying the dangerous emanations from sewers, the system may be generally applied with great advantage; and that from the experience derived from this extensive practical inquiry, they are satisfied that the expense of the system might be considerably reduced below that indicated by the cost of the experiment.

Professor Gamgee's Method of Preserving Meat.—The necessity of some plan for preserving meat has long been felt. Hence it is that every plan, as soon as announced, is seized by the anxious public. If we may believe late reports from London, this desire is at last soon to be gratified, and in a manner which will leave nothing desirable unaccomplished. It seems that Professor Gamgee, President of the Albert Veterinary College of London, author of several works upon the cattle plague, and a recognised authority in such matters, discovered a new process for preserving meats, which he has patented in Europe and America. The process is simple and quite inexpensive. The animal, when practicable, is caused to inhale carbonic oxide gas. Before it is quite insensible it is bled in the usual way. When dressed the carcase is suspended in an air-tight receiver, the air exhausted, and the receiver filled with carbonic oxide gas; a small quantity of sulphurous acid gas is also added. After remaining here for from 24 to 48 hours, meat may be removed, and hung in a dry atmosphere; it will keep for one, two, or three months, or longer, with no perceptible change in taste or appearance. The tests of the method thus far applied have been attended with success. Beef killed in London in March last was sent to New York in June, and as late as the middle of July was shown to a prominent butcher in Fulton market, who did not discover that it was other than ordinary beef, and expressed the opinion that it had probably been killed about two days. Mutton killed in London last July, and sent to this city soon after, is now perfectly fresh, and one piece of beef kept for ten days in a can surrounded by water at a temperature of 90 to 100 degrees, came out perfectly fresh. The process, in the opinion of eminent chemists, does not injure the meat in the least, which is an advantage very difficult of attainment, even in the case of transportation of live stock, which is liable to the bad effects of confinement and the length of the journey. Among the beneficial results of the adoption of this scheme would be a better supply in our markets of wholesome meat and at a desirably cheaper rate. It is expected that Prof. Gamgee will soon visit this country for the purpose of inaugurating his project.—*American Journal of Mining.*

Production of a Fragrant Substance from Resin (probably an essential oil).—Common resin, lac, or kauri gum, in a state of powder, is gently heated with somewhat dilute nitric acid for a few hours; the mixture or the solution, as the case may be, is then evaporated to dryness, or nearly so, and treated with an excess of a strong solution of common soda, caustic potash, or lime in water; the resulting liquid is then transferred to a retort, and distilled; at first the distillate has an odour of garlic, but this gradually gives way to an odour decidedly fragrant. On redistilling the portion last drawn over from concentrated sulphuric acid, a strong aqueous solution of this odourous substance is obtained, the solution itself has a warm aromatic flavour, and the odour assimilates to that of peppermint mixed with lavender. Bichromate of potash with sulphuric acid, also, may be used for the oxidation of the resin employed. —W. Skey.

Champagne from Petroleum.—It is no longer a secret of the chemist's laboratory that clear golden syrups can be made from starch and sulphuric acid; that delicious wines and brandies can be made from beet-root; that a barrel of peanuts can be transformed into excellent coffee; that lard can absorb an enormous quantity of water in certain conditions; that in fact there seems no limit to the adulterations that an intelligent and dishonest chemist can practice upon his fellow-men. All these marvels of chemical science have in these latter days become degraded into mere tricks of trade, and their chief beauty is in their capacity to enable unscrupulous dealers to lighten the pockets and destroy the stomachs of the confiding and consuming public. Concerning the article of champagne, a writer in the Portland (Maine) *Star* tells us that it is made from a thousand different substances—even from refined petroleum. Yes, from the fiery benzoles a sparkling, bubbling, foaming champagne can be produced which will delight the eye, tickle the palate, gladden the heart momentarily—but quicken our paces toward the graveyard. This is a new use for petroleum, which those who have been experimenting with it as an agency for generating steam have little dreamed of. Who can say that the Pennsylvania oil territory, now considered mostly worthless, may not some day be regenerated into the great champagne-producing country of the world.—*Cincinnati Journal of Commerce.*

Patents by Scientific Men.—"Wollaston was fond of amassing money. There have not, indeed, been wanting accusations to the effect that if he had sought less after wealth, he would have done more for science. How far these charges are true, we have no means of judging, as it does not appear from the published accounts in what exact way he made his money. That it was chiefly by the platina process is certain; but whether he engaged in the manufacture himself, or only superintended it, we do not know. On this point we would only remark, that there is something, to say the least of it, very partial and unfair in the way in which obloquy is cast upon men of science, if they appropriate to themselves some of the wealth which their discoveries procure for others. If a successful naval or military hero is lavishly pensioned out of the public purse, no one complains. It is not thought strange that a great painter or sculptor, while he justly declares his productions are worth untold gold, should, nevertheless, demand a modicum of coin from his admirers. Neither is the poet or musician blamed who sells his works to the highest bidder. But if a chemist, for whom there are few pensions and no peerages, thinks to help out a scanty or insufficient income, by manufacturing gunpowder, like Davy, or magnesia, like Henry, or malleable platina, like Wollaston, or guano, like Liebig, the detractors assail him at once. He has lowered the dignity of his science, and, it would seem, should starve rather than degrade his vocation. That vocation, so far at least as the practical fruits of his own labours are concerned, is to be a kind of jackal to start game which others are to follow—a beagle to hunt down prey which others may devour. Surely there is but scanty justice here, and some forgetfulness of a sacred text:—'Thou shalt not muzzle the mouth of the ox that treadeth out the corn, &c.'"—*From the British Quarterly Review*, No. vii. (*August*, 1846), *Article* 3, *p*. 104.

CONTEMPORARY SCIENTIFIC PRESS.

Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Archives des Sciences.
November 25, 1867.

M. Delafontaine, "On some new and little known Molybdates, and on the principal Fluoxymolybdates." J. L. Prevost, "Researches on the Poisonous Action of Veratrine."

Journal des Fabricants de Papier.
December, 1867.

E. Bouadilliat, "On Testing the Chemical Products used in Paper Making. (Continuation.) Vegetable Colouring Matters." Mansta, "A new Composition for rendering Canvas Waterproof."

Comptes Rendus.
December 9, 1867.

A. Secchi, "On Stellar Spectra, and on Shooting Stars." E. Bourgoin, "On the Electrolysis of Acetic Acid."

Monatsbericht der Koniglich Preussischen Akademie der Wissenschaften zu Berlin.

C. A. Martius, "On Binitronaphthol."

Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften zu Wien. (Mathematisch-Naturwissenschaftliche Classe.)
June, 1867.

E. Boricky, "A Contribution to the History of the Formation of the Phosphates of Iron: Dufrenite, Beraunite, and Kakoxene from the Hrbek Mine near St. Benigna, Bohemia." V. von Zepharovich, "Mineralogical Notes, Part II.: 1. Barrandite from Cerhovic and Sphærite from Zajecov. 2. Boulangerite and Jamesonite from Pribram. 3. Mispickel. 4. Lollingite and Leucopyrite."

Bulletin de la Société Chimique de Paris.
November, 1867.

Berthelot, "On the Simultaneous Formation of Homologous Bodies in Pyrogenous Reactions." E. Perret, "On Refining Crude Camphor."

Annalen der Chemie und Pharmacie.
November, 1867.

E. Linnemann, "On the Transformation of Amine Bases into the corresponding Monatomic Alcohols." A. Siersch, "On the Transformation of Ethyl-Alcohol into Propyl-Alcohol." A. Saytzeff, "On the Action of Iodide of Methyl on Sulphide of Amyl-Ethyl." "On the Action of Nitric Acid on Sulphide of Methyl and Sulphide of Ethyl." N. Morgunoff, "On Stannidimethyldiethyl." F. Beilstein and U. Kreusler, "On Para-nitrotoluylic Acid and its Derivatives." C. Schorlemmer, "Contributions to the Knowledge of the Hydrocarbons." M. Fleischer, "On Thionessal." L. Scheller, "On some Double Salts of Sulphate of Uranium." F. Wohler, "On a Compound of Chloride of Thallium with Perchloride of Iron." "Contributions to the Knowledge of Cerium."

Supplement.

L. Meyer, "On the Molecular Volume of Chemical Compounds." H. Schiff, "Researches on the Boracic Ethers." J. Erdmann, "On the Composition of the Wood of *Pinus abies*." H. L. Buff, "On the Transformation of Monochlorhydrin into Propyl-glycol and Lactic Acid, and of Bichlorhydrin into Isopropylic Alcohol and Acetone."

NOTES AND QUERIES.

Estimation of Chlorine.—Can any one inform me of any more ready and reliable mode of estimating the feebly combined chlorine in bleaching powder, than the old protosulphate of iron test?—S. Dunn.

Palm Oil for Softening Dyed Yarns.—Would any of our kind friends inform me if there is any method to make palm oil mix with water, without the use of alkalies; if not, the best means to mix the above, so that it will not be injurious to colours?—Needful.

Electro-deposition of Iron.—Having occasion to electro-deposit iron on to a metallic surface of copper, and having at hand a solution of ferrous sulphate, slightly acidulated with sulphuric acid, and consisting of 1 part of the crystalline salt to 5 parts of water, I desired to ascertain, before making a stronger and, perhaps, more suitable solution for the purpose, whether the deposit from this solution would be reguline. On applying the galvanic current from three of Smee's battery cells (arranged in series) to this solution in the cold, I found that a reguline deposit of white, silvery-looking iron was obtained, but with the evolution of hydrogen gas in considerable quantity. Although certain alkaline solutions are known that will readily give up their metal in a reguline form during the rapid evolution of hydrogen, thus forming exceptions to "Law I." in "Smee's Electro-Metallurgy" (3rd ed., p. 150), this is the first instance that has been met with, to my knowledge, of a solution similar to the above, and containing no alkali or other metal than the one to be thrown down, giving, by electrolysis, a reguline metallic deposit during the evolution of hydrogen. Each Smee's cell had 18 square inches effective area of positive surface; but the area of the anode and cathode, respectively, was 2 square inches. The battery exciting liquid was 1 part of oil of vitriol to 20 parts of water. As evidenced by a galvanometer in the circuit, the addition of a solution of sulphate of ammonium to the solution increased its conducting power; with this latter solution a very serviceable coating was obtained, but still with the evolution of hydrogen gas. I give these details in order that others may try the experiment, if they feel so inclined.—W. H. Walenn, F.C.S., 19, Talbot Road, Tufnell Park West, N.

MEETINGS FOR THE WEEK.

Monday.—Royal Institution, 2. General Monthly Meeting.
Wednesday.—Geological, 8. "On the Affinities and probable Habits of the extinct Australian Marsupial, *Thylacoleo carnifex*, Owen." By W. H. Flower, Esq., F.G.S., "On the Thickness of the Carboniferous Rocks of the Pendle Hills," by E. Hull, Esq., F.G.S. "On the relative Ages of the leading physical Features of the Carboniferous districts of Lancashire and Yorkshire," by E. Hull, Esq., F.G.S. "On a Saliferous Deposit in St. Domingo," by D. Hatch, Esq. Communicated by Sir R. I. Murchison, Bart., F.R.S., &c.
— Microscopical, 8.

TO CORRESPONDENTS.

Helta.—Use ammonia in preference to potash for precipitating the earths. You can always get rid of ammoniacal salts by ignition towards the close of an analysis.

John S. M.—The Chemical Society's Journal is no longer published by Baillière, but by Van Voorst.

Assayer.—German silver cannot be assayed in the dry way owing to the difficulty of removing the nickel. In assaying brass and gunmetal the oxides of zinc and tin are so difficultly fusible that the dry process is also inapplicable to these alloys. An alloy of copper and silver, or copper and gold, may be assayed by cupelling with lead and determining the copper by the loss.

Walter H.—A private letter will be sent if you forward your address.

Mineral.—The ore contains copper in considerable quantity, and also some silver. If you wish to have a quantitative analysis of it, will you be good enough to communicate with the Editor?

Communications have been received from J. S. Muter; Dr. Adolph Ott; W. Angell; W. F. Barrett; H. Henderson (with enclosure); H. W. Lloyd Tanner; W. N. Hartley; M. Stanilas Meunier (with enclosures); J. Hargreaves (with enclosures and newspapers); T. F. Higginson; John Horsley (with enclosure); Charles Cochrane; W. N. Smythe; Nicholson, Maule, & Co.; Dr. Adriani (with enclosures); A. P. Hurlstone; W. Selton; W. Skey (with enclosures); J. Williams; J. Stevenson; W. Bockhart Smith; Messrs. Longmans & Co.; Neil Matthieson; A. Coppins; J. Robertson & Co.; J. J. Lundy & Co.; W. Hall; Rev. R. Kirwan; J. C. Burrell, Sydney, N.S. Wales (with enclosure); Magnesium Metal Co.; Dr. Watts; Dr. Dupré; C. M. King; Rev. B. W. Gibsone, M.A.; J. H. Atherton.

Books received.—"Official Record of the Intercolonial Exhibition of Australasia." Melbourne: Blundell & Co.; "A Treatise on the Metallurgy of Iron," by H. Bauerman, F.G.S. London: Virtue & Co.; "Popular Science Review;" "Pharmaceutical Journal;" "Scientific American;" "American Journal of Mining;" "American Artisan."

THE CHEMICAL NEWS.

Vol. XVII. No. 436.

ON NAPHTHA AND ILLUMINATING OIL FROM HEAVY CALIFORNIA TAR.

AND ON THE PROBABLE ORIGIN OF PETROLEUM.

By Prof. B. SILLIMAN.

Having lately had an opportunity to examine a specimen of "surface oil," so called, from Santa Barbara county, in California, I present the following experimental results in the hope that they may not be without interest, as an addition to our knowledge of one extreme of that class of hydrocarbons, which occur in nature in the fluid form, and of every density, from those which are but little lighter than water, down to the lightest naphtha found in a natural state.[*]

It is proper to state that the chemical examination of this sample had chiefly a technical object, to prove whether or not illuminating oil of good quality could be obtained from the distillation of so dense a body. The experiments were conducted on quantities of from five to ten gallons each. The crude oil was very dark, almost black, transmitting yellow brown light in thin films. At ordinary temperatures (60° F.) it is a thick viscid liquid resembling coal tar, but with only a very slight odour.

Its density at 60° F. is 0·980, or 13½° Baumé. It retains, mechanically entangled, a considerable quantity of water, which is neutral in its reaction. The odour of sulphydric acid, which is very decided in this product, as I have noted in its locality, had entirely disappeared in the specimen under consideration.

The tar froths at the commencement of distillation, from the escape of watery vapour. It yields by a primary distillation no product having a less density than 0·844 or 37° B. at 52° F.

Distillation to dryness produced in two trials an average result as follows:—

Oil having a density of 0·890 to 0·900	69·82
Coke, water, and loss	30·18
	100·00

In one of these trials the product was divided as follows:—

Oil of density 29° B. at 52° (885 sp. gr.)	50·
Oil of density 24·75 B. at 58° (908 sp. gr.)	17·5
Coke, water, loss, &c.	32·5
	100·0

The coke is very large in quantity, strong, and is a good fuel, resembling gas-house coke. The odour of ammonia is given off towards the close of the distillation. It is well known to distillers of petroleum that by the process called "cracking," heavy oils unfit for illumination are broken up into bodies of less density, from light naphtha to the heavier illuminating and lubricating oils. This process is simply the application of a carefully regulated heat producing a slow distillation. By this treatment the molecules apparently re-arrange themselves into groups of different density, which by a subsequent distillation are divided into fractions (or "heaps," as Mr. Warren calls them) of tolerably constant boiling points.

The first distillate, having a density of about ·890 at 6° F., treated in this manner, yielded a product having a density of about ·885 at 60°, or only 1° Baumé lower than before distillation. After treatment with sulphuric acid and soda and redistilling from soda, it had a density of ·880 at 60° F. Upon distilling, 100 measures of this last distilate yielded:—

Light oil having a density of about ·835 at 60° F ..	21·58
Heavy oil having a density of about ·880 at 66° F..	37·41
Heavy oil having a density of about ·916 at 64° F..	34·53
Coke &c...	6·48
	100·06

In another experiment undertaken with a view to "cracking," &c., treating and re-distilling with soda, the products were as follows, stated in percentages of the whole quantity operated on, the several steps being as before:—

Naphtha,[†] sp. gr. about ·760 at 60° F.	11·33
Oil,[‡] sp. gr. about ·836 at 60° F...	66·22
Oil, sp. gr. about ·893 at 60° F.	12·67
Oil, sp. gr. about ·921 at 60° F.	3·56
Loss	6·22
	100·00

The illuminating oil from both these experiments, after treatment with sulphuric acid and soda in the usual manner, acquired an agreeable odour, a light straw-yellow colour, and burned as well in a lamp as good commercial oil.

With a view to test the effect of heat aided by pressure in breaking up the heavy hydrocarbons—a method of treating heavy hydrocarbon oils patented in 1866 by James Young, of Glasgow—a portion of the first distillate from the crude oil was subjected during distillation to a pressure of 10 to 15 pounds to the square inch, in an apparatus adapted to the purpose, the distillate thus obtained being about the same density as in the first-named experiment, ·890 at 60° F.

From this distillate were obtained, after the ordinary treatment with sulphuric acid and soda, the following products:—

Light oil, sp. gr. ·825 at 60° F. ..	19·2 per cent.
Heavy oil, sp. gr. ·885 at 60° F. ..	25·86 ,,
Heavy oil, sp. gr. ·918 at 60° F. ..	38·14 ,,
Coke, loss, &c...	16·80 ,,
	100·00

The illuminating oil from the last experiment flashed at 80° F., and lighted on the surface at 85° F., showing the presence of naphtha or some very light body, the quantity of which cannot be very considerable. The light oil could, with care, be taken off in practice without materially diminishing the yield of illuminating oil. It would be rash to conclude that there may not be an important economical advantage in employing in the large way, Mr. Young's method of treatment, under pressure, over that of "cracking" by a regulated heat alone. It is highly probable that there would be found an important saving of time, as under a regulated pressure, and a corresponding increase of temperature, the transformation of the heavy oils into a mixture of less density will occur more speedily. The experiments herein mentioned gave nearly the same result, whether pressure was used or not; a certain loss, all falling upon the lighter portions, was found to result from leakage of the apparatus under pressure, which in the larger way of operating commercially could be avoided.

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[*] I am indebted to A. J. Corning, formerly assistant to Mr. Warren, for conducting this research under my direction; and to Messrs. Downer and Merrill, of the kerosene works in South Boston, I am under many obligations for the permission to employ their operative laboratory in conducting this research. For the crude material operated on I am indebted to the Californian Petroleum Company, from whose estate it was derived.

[†] This naphtha caught fire from a match at an atmospheric temperature of 50° F.

[‡] This oil flashed at 113° F., and ignited at 124° F.

No paraffine could be detected by refrigerating the heavy oils obtained in these distillations in a mixture of salt and ice. It is no doubt, the absence of this body from the series of products obtained from the California oils generally, that accounts for the illuminating oil burning well at a density considerably below the commercial standard for oil obtained from Pennsylvania petroleum—a difference enhanced also by the absence of any considerable quantity of light naphtha. The lubricating oils of this series, likewise free from paraffine, retain on this account their fluidity at low temperatures.

The light oils obtained in this series of experiments correspond respectively to 12·96, 14·56, and 18·96 per cent of the crude oil. The total commercial products are about 60 per cent of the crude body, which likewise yields sufficient coke to supply the fuel required in the distillations.

In the large way of returning the lightest oils to the heavier portions in the successive distillations, and employing Mr. Young's method by pressure, it is probable the product of light or illuminating oils may be raised in these very heavy natural products to 30 per cent, and for those of less density the proportion will be correspondingly greater.

It is evident from these experiments that heavy hydrocarbon oils containing no naphtha are convertible into oils of the naphtha series under the action of heat by molecular transformations, the excess of carbon being left behind as coke; each successive distillation eliminating a new, bnt always diminished, portion of carbon. It may, therefore, be confidently affirmed, that even the heaviest of the California hydrocarbons belong to, and are derivatives from, the petroleum series. The transformation of light oils into denser products ending with tar, like that which is the subject of this research, results not, as has been assumed by some, from the addition of oxygen producing an oxidised body, but on the contrary, by the removal of successive atoms of hydrogen in the form of water, thus leaving the carbon in excess, that excess being left behind in the form of coke when the crude product is distilled.—*From the San Francisco Bulletin.*

ON THE

PRECIPITATION OF COPPER AND NICKEL BY ALKALINE CARBONATES.

By WOLCOTT GIBBS, M.D.,

Rumford Professor in Harvard University.

THE precipitation of copper by zinc, or by the electrolytic method, requires that the metal should be present in the form of sulphate or chloride, and does not succeed with the nitrate. As stated before, the employment of the hypophosphites is limited to the case in which the metal exists as sulphate. The old mode of precipitating copper as oxide by caustic potash has disadvantages which are familiar to all chemists, but on the other hand is independent of the nature of the solution of copper employed, so long at least as no organic matter is present. According to Rose,[*] the alkaline carbonates precipitate copper less completely than caustic alkalies. This statement, however, is not accurate for *all* the conditions under which the experiment may be performed; and I have found that copper may be completely precipitated from the sulphate, nitrate, or chloride when the solutions are boiled together for a sufficient time and are sufficiently dilute. Mr. E. R. Taylor, who has made a careful study of this method of determining copper, has arrived at the following as the best method of conducting the process. The solution of copper is to be diluted with water until the liquid contains not more than about 1 grm. of the metal in one litre. A solution of carbonate of potash or soda is then to be added in small excess, and the whole boiled for about half an hour. The boiling proceeds quietly, and without succussions; the blue green carbonate soon becomes dark brown, and has a fine granular character which renders it extremely easy to wash. After washing it is to be ignited in an atmosphere of hydrogen, and the copper weighed as metal; it will be found to be free from alkali. In this manner Mr. Taylor obtained, in five analyses, the following results:—

1·8384 gr. pure sulphate of copper gave 0·4688 gr. metallic copper = 25·44 per cent.

1·7144 gr. pure metallic copper dissolved in aqua regia gave 1·7161 gr. copper = 100·09 per cent.

1·3860 gr. pure metallic copper dissolved in aqua regia gave 1·3853 gr. copper = 99·93 per cent.

1·4657 gr. pure metallic copper dissolved in nitric acid gave 1·4670 gr. copper = 100·09 per cent.

1·4685 gr. pure metallic copper dissolved in nitric acid gave 1·4634 gr. copper = 99·65 per cent.

The filtrate is perfectly free from copper if the process has been well conducted.

The ignited oxide is in a state of great subdivision, and the ignition must therefore be conducted with much care to avoid loss. A small portion of the oxide or basic carbonate usually adheres to the sides of the vessel in which the boiling takes place. This is to be re-dissolved, and again precipitated, but great care must be taken not to add a large excess of the alkaline carbonate, which gives a solution from which the copper is not precipitated by boiling.

Nickel may be completely precipitated from its solutions by precisely the same process. The green basic carbonate may be washed much more readily than the oxide precipitated by caustic alkali; it is to be ignited and weighed as oxide. In two analyses Mr. Taylor obtained the following results:—

1·9808 gr. anhydrous sulphate of nickel gave 0·9551 gr. $\mathrm{Ni\Theta}$ = 37·79 per cent.

1·4601 gr. anhydrous sulphate of nickel gave 0·7008 gr. NiO = 37·64 per cent.

The formula $\mathrm{NiS\Theta_4}$ requires 37·69 (Ni = 58). Dr. F. A. Genth informs me that he has also used the alkaline carbonates in precipitating nickel, and with most satisfactory results.

The precipitation of cobalt by an alkaline carbonate can only, with much difficulty and by long boiling, be made complete. As a means of determining cobalt it is not to be recommended. On the other hand, Mr. F. W. Clarke has found that cobalt is completely and easily precipitated by the process of oxidation, first given by Popp,[†] which consists in neutralising the solution with carbonate of sodium, adding acetate of sodium, and then boiling with an excess of an alkaline hypochlorite, taking care to keep the solution alkaline. The hydrated sesquioxide (?) of cobalt thrown down may be readily washed. After reduction in hydrogen, the metal is found to be free from alkali. Nickel may, as Popp has also shown, be precipitated in the same manner, but the process given above seems to me preferable.

In this connection I may be permitted to state that the method of separating cobalt from nickel by means of peroxide of lead attributed to myself in the new edition of Rose's[‡] "Handbuch der Analytischen Chemie," and also ascribed to me by Gauhe[||], was never even proposed by me.

Cobalt and nickel may be precipitated from neutral solutions of their sulphates, nitrates, and chlorides by adding first an excess of oxalic acid to the concentrated solution, and then a large excess of strong alcohol. After standing a few hours the filtrate is perfectly free from metal. The oxalates are very easily washed. This method is, however, rarely available for analytical purposes, since it fails entirely when salts of ammonium or of the alkaline metals are present. The oxalates are also in such a state of subdivision that it is almost impossible to ignite them without loss. The oxides of copper, cadmium, zinc, manganese, and magnesium, are also completely precipitated from their sulphates by oxalic acid and alcohol, but not in presence of alkaline salts. The same is true of both mercurous and mercuric nitrates. In the few cases in which this mode of precipitation will find application in practice, it will probably be best to determine the oxalic acid in the oxalate by hypermanganate of potash.

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[*] Handbuch der Analytischen Chemie, ii, 175. Sechste Auflage.

[†] *Zeitschrift für Analytische Chemie.*

[‡] Sechste Auflage, Bd. ii., p. 143.

[||] *Zeitschrift für Analytische Chemie.*

In a former paper I have stated that the sulphides of cobalt and nickel thrown down from boiling solutions by a boiling solution of sulphide of sodium may be washed without oxidation upon the filter. The difficulty of preparing pure sulphide of sodium has, however, been an objection to this method.[§] This difficulty may easily be removed by dissolving the crystallised tetrahedral sulphide, $Na_2S + 9aq$, in alcohol of 90 per cent, filtering, and allowing the solution to crystallise. After two or three crystallisations, the pure sulphide may be dried over sulphuric acid in vacuo, and the white effloresced mass preserved in a well stoppered bottle. The sulphide is chemically pure.—*Amer. Journ. of Science and Arts.*

ON CRYOLITE AND ITS PRODUCTS.

By EVAN T. ELLIS.

This remarkable mineral, which is partially transparent, of a vitreous lustre, and brittle texture, is a fluoride of sodium and aluminium, containing

13 per cent aluminium,
34 ,, sodium,
53 ,, fluorine,
100

It is found in an immense deposit in Greenland, at Iviktout, at the head of Arksut Bay, near Cape Farewell. The first discovery was made by one of the missionaries, who carried a specimen with him to Copenhagen. Its true composition was determined by Vauquelin. There is a bed 80 ft. thick, and 300 ft. long, at the above-mentioned place.

It is frequently associated with the salts of metals, and beautiful crystals, of galena, or sulphide of lead, chalybite, or brown spathic carbonate of iron, resembling spar in lustre; copper pyrites with silver, iron pyrites, &c., are found therein, arranged in masses segregated from the white, transparent, ice-like cryolite.

It remained for the Pennsylvania Salt Company to introduce to our country this valuable material. This energetic Company, whose works are in western Pennsylvania, has secured the privilege of using a large part of all that is mined, and has, within two years past, imported into Philadelphia thirteen cargoes, or 9,000 tons, which have been sent to their works for manufacture.[*] The greater portion of this has been used for their patent saponifier. They are now devoting their attention to the preparation of caustic soda, carbonates, and other salts of soda, sulphate of alumina, &c.

Soda is obtained from cryolite by simply mixing with lime, and subjecting to heat. The fluorine combines with the calcium, forming fluoride of calcium; while the remaining metals absorb oxygen from the air, and become alumina and soda. Carbonic acid is then passed through the solution, forming, with the sodium, a carbonate of soda, which remains suspended, while the alumina, being insoluble, is deposited at the bottom of the vessel. The carbonate of soda is deprived of its acid by means of lime in the usual manner, and thus rendered caustic, and fitted for the use of the soap-maker.

One hundred pounds of cryolite yield—

44 lbs. dry caustic soda,
or 75 ,, ,, carb. ,,
or 203 ,, crystal carb. ,,
or 119½ ,, bicarb. ,,
and 24 ,, alumina.

The sulphate of alumina contains 2·82 of sulphuric acid to 1 equivalent of alumina, therefore this is more than a neutral salt (3· being neutral), which is very desirable for manufacturers of paper, calico printers, &c.[‡] It is also entirely free from iron, another very important characteristic.

There is another very important use to which cryolite can be applied. By a fusion of 1 part of cryolite with from 2 to 4 of pure silex, a beautiful glass is formed, susceptible of mould and polish, and capable of being manufactured into an endless variety of useful and ornamental articles, and probably many utensils for chemical and pharmaceutical use will be made of it. A company has been operating in Philadelphia for some time past, on an experimental scale, entitled the "Hot Cast Porcelain Company." The results have been so satisfactory that they have now taken a large establishment, and will be prepared to carry on the manufacture quite extensively. The cost is, at present, from 10 to 20 per cent higher than ordinary flint glass. The ware seems to be stronger than glass.—*Proc. Am. Pharm. Association.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 2, 1868.

Dr. Warren de la Rue, F.R.S., &c., President, in the Chair.

The minutes of the last ordinary meeting were read and confirmed, and the library donations were acknowledged. The following gentlemen were ballotted for and duly elected Fellows of the Society, viz.: John Tyndall, LL.D., F.R.S., Lecturer on Natural Philosophy in the Royal Institution of Great Britain; Frederic Guthrie, Ph.D., F.R.S.E, Lecturer on Chemistry in the Royal College of Mauritius; William Brantingham Giles, Old Swan, Liverpool. For the first time was read the name of Mr. Thomas Bournes, Teacher of Chemistry, 47, Rigby Street, St. Helen's Lancashire; and for the second time, Francis C. H. Clarke, Lieutenant Royal Artillery, Staff College, Farnborough Station.

Mr. W. H. Perkin read a paper "*On the Constitution of Glyoxylic Acid*," of which Mr. Duppa and himself were joint authors. The starting-point in the formation of this body was dibromacetic acid, and this converted into the silver salt and heated under water, furnished a product described in the original research (1859) as "a new acid having the formula $C_2H_4O_4$."[*] This body has since been regarded as glyoxylic acid. The authors now resume the description of this acid, and quote analysis in proof of the correctness of its formula. They have further ascertained by comparative examination of the calcium and silver salts that this acid is in all respects identical with the glyoxylic acid obtained by Dr. Debus as a product of the oxidation of alcohol. The method followed in the purification of the dibromacetic acid is fully described in the paper, and consists in the etherification of the crude acid, conversion into amide, and repeated crystallisation of the latter, when all the mono-bromacetamide is left in solution. The purified amide is then decomposed by hydrate of potassium, added by small portions at a time, and in a vessel surrounded by ice-water. The ammonia liberated is neutralised by dilute nitric acid, and the solution mixed with nitrate of silver, when the dibromacetate of that metal is precipitated. This is said to be not affected by light, although Dr. Debus asserts the contrary. The silver salt is diffused through a considerable quantity of water, and exposed to the temperature of 100° C. until no more yellow bromide of silver is formed, which filtered off leaves bromoglycolic acid in solution. This, in turn, is again converted into its silver salt, and decomposed in a similar manner, yielding bromide of the metal and pure glyoxylic acid in solution. The authors have discovered a very characteristic test for this acid dependent upon the ease and rapidity with which the aniline salt is decomposed. This combination, at first colourless, lets fall a bright orange-coloured precipitate, either on standing at rest for some time, or immediately upon heating. It is impossible within the limited space at our disposal to do justice to the authors' arguments in support of their views respecting the constitution of glyoxylic acid, which occupy more than half the length of their paper.

[§] American Journal of Science and Arts, vol. xxxvii, p. 350; also Zeitschrift für Analytysche Chemie, Bd. iii, p. 392.

[*] They imported last year (1867) eight thousand tons.

[‡] The English often contains as high as 3·27 of acid.

[*] Journ. Chem. Soc., vol. xii. p. 6.

Dr. ODLING read a paper "*On a Glyoxalic Amide.*" In the course of an examination into the properties of the remarkable compound $NOCl_2$, obtained by Gay-Lussac as the chief product of the reaction of nitric and hydrochloric acids, he had made preliminary experiments on the action of this substance upon a variety of compounds, with the view of introducing the group NO in exchange for hydrogen; or of otherwise obtaining some evidence from the reactions of the substance in favour or disfavour of Gay-Lussac's formula, which he did not consider as being at present satisfactorily established. From the result of a preliminary experiment, he had been induced to study the reaction of Gay-Lussac's body with alcohol more in detail. His results were at present in an incomplete state, and he would not have ventured to bring them before the Society just yet, but for the bearing they had upon the experiments of Messrs. Perkin and Duppa, with whom he had been in communication.

Absolute alcohol absorbed Gay-Lussac's body abundantly in the cold, apparently without decomposition; but after a time the temperature rose rapidly, and an unmanageably violent reaction set in. At the temperature of 40° or 50°, however, there was no mere absorption of of the chloro-nitric vapour, but it acted continuously upon the alcohol, with copious evolution of hydrochloric acid. The product of the reaction was heated on a water-bath, whereby the excess of alcohol, containing apparently some chloral, was distilled off, and a syrupy liquid was left, which was further heated for some time on a water-bath, while being treated with a current of dry carbonic acid gas.

On moderate dilution, this syrup yielded a watery solution and an oily deposit. The latter was first examined, but he would now refer, first, to the solution. Being extremely acid, it was neutralised with chalk, and the solution of the resulting lime salts evaporated, whereby what appeared to be a magnificent crop of crystals was obtained, but the apparent crystals were in reality masses of crystalliform jelly. The jelly was dissolved in water, the solution precipitated by alcohol, the precipitate redissolved in water, and reprecipitated by alcohol once or twice until obtained free from chlorine. From the aqueous solution of the final precipitate, crystals were obtained, which an ultimate analysis and examination of their properties showed to be glyoxalate of calcium. In particular, they gave the interesting aniline reaction which Messrs. Perkin and Duppa had just described. Dr. Odling was of opinion that the treatment of alcohol with Gay-Lussac's body constituted the most productive process yet described for the preparation of glyoxalic acid. He had not ascertained whether the jelly he had referred to was or was not a definite compound of glyoxalate and chloride of calcium. The results of his analysis of the pure glyoxalate corresponded with those of Dr. Debus and of Messrs. Perkin and Duppa, and accordingly the salt might be represented by either of the formulæ

$$\frac{Ca}{2}HCO_3.H_2O \text{ or } \frac{Ca}{2}H_3CO_4.$$

The oil having been washed with dilute potash and water, was dried over chloride of calcium, and distilled. A portion boiled between 100° and 160°, without giving an indication of any fixed point; by far the larger portion boiled between 180° and 200°; and another portion boiled between 240° and 250°. The portion boiling between 180° and 200° had alone been submitted to examination. Its rectification was very troublesome, owing to the principal constituent being mixed with one or more substances decomposible by distillation. At length a liquid was obtained, boiling at 189°, which was thought to be pure. Analysis, however, proved that it was very far from pure. Its behaviour with potash having shown it to be an ether, it was accordingly treated with ammonia, in the first instance with alcoholic ammonia in sealed tubes, afterwards with strong aqueous ammonia and sufficient alcohol to cause the two liquids to dissolve in or mix with each other. On spontaneous evaporation, a beautiful crystalline substance was obtained, having much the appearance of chlorate of potassium or nitrate of silver, the perfect crystals occurring as rectangular plates. It melted at about 77°, and was capable of being boiled and distilled; but on attempting to take its vapour density it underwent decomposition. It was very soluble in water and alcohol, forming neutral solutions, which did not evolve ammonia when treated with potash in the cold. The numbers obtained by its analysis were in accordance with the formula $C_6H_{13}NO_3$. From a consideration of its properties and mode of formation, it might be regarded as an amide of Messrs. Perkin and Duppa's acid, in which the two alcoholic hydrogens were replaced by ethyl, thus:—

$H_4C_2O_4$	Glyoxalic acid.
$H_5C_2O_3N$	Its unknown amide.
$Et_2H_3C_2O_3N$	The diethyl-amide.
$Et_2H_2C_2O_4$	The unknown corresponding acid.
$Et_3H\ C_2O_4$	Its ether.

The further examination of the ether from which the amide had been prepared was not complete, but enough had been done to show that in all probability it was the compound $Et_3HC_2O_4$.

It would thus be seen that Dr. Odling's experimental results were in perfect harmony with those of Messrs. Perkin and Duppa. The interpretation of both sets of results, however, he considered still an open question—and a most important one—which further experiment alone could positively solve. But with the imperfect materials at present available, he would state what he considered to be the arguments for and against each view of the constitution of glyoxalic acid. Starting from aldehyd and alcohol, he believed that all chemists entertained the same notion as to the constitution of those compounds, although some chemists expressed their notion by means of reasonable, and others by means of unreasonable formulæ (Laughter). Aldehyd contained two marsh-gas residues, one of which was in its primitive state, while the other had undergone the aldehydic modification, or had lost two atoms of hydrogen in exchange for one atom of oxygen, thus:—

$$HOC\underbrace{.C}H_3.$$

Similarly, alcohol was composed of two marsh-gas residues; one of which was in its primitive state, while the other had undergone the alcoholic modification, or had lost a single atom of hydrogen in exchange for an atom of oxygen, the excessive equivalency of which was supplemented by addition of an atom of hydrogen, thus :—

$$(HO)H_2\underbrace{C.C}H_3.$$

According to Debus, glyoxalic acid was composed of two marsh-gas residues, one of which had undergone the acid modification, or had lost three atoms of hydrogen in exchange for two of oxygen, the excessive equivalency of which was counterbalanced by addition of an atom of hydrogen, while the other marsh-gas residue had undergone the above-described aldehydic modification, thus :—

$$HO\underbrace{C.C}O_2H.$$

But according to Perkin and Duppa, glyoxalic acid was composed of two marsh-gas residues, one of which had undergone the acid modification, while the other had undergone a sort of glycol modification, or had lost two atoms of hydrogen in exchange for two atoms of oxygen, the excessive equivalency of each of which was supplemented by an added atom of hydrogen, thus :—

$$(HO)_2H\underbrace{C.C}O_2H.$$

In favour of Perkin and Duppa's view might be urged, 1st, the complete accordance of their formula with the ascertained composition of glyoxalate of calcium, of diethylated glyoxalic amide and ether, and of most glyoxalates; 2nd, its accordance with the ingenious transformations and re-transformations which Messrs. Perkin and Duppa had just described. Against it might be urged, 1st, its *à priori* improbability, on the ground that two atoms of hydrogen cannot be replaced by hydroxyl in marsh-gas itself, and are not known to be so replaced in any constituent marsh-gas residue, although subjected to processes similar to those by which glyoxalic acid is produced; 2nd, its want of accordance with the remarkable aldehydic characters of glyoxalic acid; 3rd, its want of accordance with the composition of crystalline glyoxalate of ammonia.

In favour of Dr. Debus's view might he urged, 1st, the necessary existence of the body represented by his formula, and its necessary possession of the joint aldehydic and acid characters exhibited by glyoxalic acid :—

$HO\underbrace{C.C}OH$	Glyoxal
$HO\underbrace{C.C}O_2H$	Glyoxalic acid.
$HO_2\underbrace{C.C}O_2H$	Oxalic acid.

2nd. Its complete accordance with the aldehydic characters of glyoxalic acid, as shown by its power of reducing oxide of silver, of combining with the acid sulphites, and of breaking up under the influence of alkalies into alcohol and acid, just as does aldehyd itself:

$$2HO\underbrace{C.C}H_3 + H_2O = (HO)H_2\underbrace{C.C}H_3 + HO_2\underbrace{C.C}H_3$$

$$2HO\underbrace{C.C}O_2H + H_2O = (HO)H_2\underbrace{C.C}O_2H + HO_2\underbrace{C.C}O_2H.$$

3rd. Its accordance with the composition of glyoxalate of ammonia, a salt made by decomposing glyoxalate of calcium with oxalate of ammonia. Against Dr. Debus's view might be urged, 1st, its necessitating the representation of glyoxalate of calcium as containing an atom of water not removable at 160°, a very suspicious circumstance, and the representation of the speaker's amide as containing an atom of ether; 2nd, its less direct accordance, but by no means positive discordance with the metamorphoses described by Messrs. Perkin and Duppa.

It must be remembered, however, that the aldehydic marsh-gas residue in aldehyd itself, and in benzoic aldehyd, &c., has the property of uniting with chloride of ethyl and chloride of acetyl, with oxide of ethyl and oxide of acetyl, and that in aldehyd with ammonia also. Hence it is not altogether surprising that the aldehydic residue of Debus's glyoxalic acid, combined as it is with a saline instead of a hydrocarbon residue, should have the property of uniting with an atom of oxide of hydrogen. Viewed in this way, the speaker's ether would be a sort of acetal, and be formed under the same circumstances as acetal, namely, by the oxidation of alcohol.

$$Et_2O.HO\underbrace{C.C}O_2Et.$$

$$Et_2O.HO\underbrace{C.C}H_3.$$

Assuming that the ether of acetal has reacted with the aldehydic marsh-gas residue to form an unstable di-ethylated glycol residue $(EtO)_2HC.$, of course the question at issue between Dr. Debus and Messrs Perkin and Duppa would become, in great measure, a verbal one.

Dr. A. W. WILLIAMSON, who at this period of the evening occupied the chair, referred to the anomalous constitution of the glyoxylate of ammonia, which did not appear to contain the additional atom of water; but the view advanced by Messrs. Perkin and Duppa received support from the fact that the silver-salt, like the acid itself, contained four atoms of oxygen.

The CHAIRMAN moved a vote of thanks both to Dr. Odling and the gentlemen already named, for the interesting theoretical considerations elicited in the previous discussion.

Mr. W. CHANDLER ROBERTS read a note "*On the Occurrence of Organic Appearances in Colloid Silica obtained by Dialysis.*" The interesting observations which formed the subject of this paper were elucidated by a series of specimens, both of artificial and natural origin, the structures of which were demonstrated by the aid of a microscope and illustrative drawings. In experimenting upon somewhat large quantities of soluble silicic acid prepared in Graham's dialyser, a portion of the liquid product was evaporated slowly in air to compare with the forms of hydrous silica left by a more rapid operation conducted *in vacuo*. All the specimens of jelly dried in air exhibited dendritic forms, varying in size from 0·2 to 0·5 m.m.; these were at first supposed to afford indications of the passage of colloid into crystalloid silica, but when magnified 90 linear they appeared as radiating fibres, and upon being further magnified 700 times each fibre resolved itself into a collection of elongated beaded cells with clusters of circular cells at intervals. Such a structure would indicate a vegetable growth, and the author concludes that the markings, which are similar to those seen in moss agates and Mocha stones, are due to the growth of fungi or mildew in the partially solidified jelly. The spores of organic life were probably derived from the air, since no evidence of similar structure was visible in the specimens of hydrous silica obtained in the desiccator. These last-named products were very like the opal from Zimapan, but contained 21·4 per cent of water.

A short note "*On the Solubility of Xanthin (uric oxide) in dilute Hydrochloric Acid,*" by Dr. H. Bence Jones, was next read. Xanthin is usually stated to be insoluble in hydrochloric acid, but the author finds it to be soluble, and had no difficulty in obtaining "six-sided crystals" upon evaporation of the acid: By microscopic examination alone xanthin would be mistaken for uric acid.

In contination of his recent "*Researches on New and Rare Cornish Minerals,*" Professor A. H. Church describes the mineral *Cornwallite*, and gives several analyses by which it is shown to consist of arseniate and hydrate of copper with a small proportion of phosphate. Neglecting the latter its formula may be written thus :—

$$Cu_32AsO_4,2CuH_2O_2,\ aq.$$

Previous analyses make this mineral appear to have in all *five* atoms of combined water, but the author believes that the error in excess is accounted for by want of care in drying the samples previously to their chemical examination.

The formula of Cornwallite, thus amended, makes it stand in nearly the same relation to Erinite amongst the arseniates, as Ehlite stands to Dihydrite amongst the phosphates. This will appear by the following comparison :—

Cornwallite	..	$Cu_3 2AsO_4$	$2CuH_2O_2$ aq.
Erinite	.. ..	$Cu_3 2AsO_4$	$2CuH_2O_2$
Ehlite	.. ..	$Cu_3 2PO_4$	$2CuH_2O_2$ aq.
Dihydrite ..	..	$Cu_3 2PO_4$	CuH_2O_2

A vote of thanks having been passed to the authors' the meeting was adjourned until Thursday, 16th instant' when the following papers will be read :—"*On Graphic Formulæ*," by Dr. Guthrie ; "*On the Tetra-phosphoric Amides*," by Dr. J. H. Gladstone ; "*A New Reaction for the Formation of Isomeric Cyanides*," by Messrs. E. T. Chapman and Miles H. Smith ; and, if time permits, one or two other papers.

GLASGOW CHEMICAL SOCIETY.

The inaugural meeting of the Glasgow Chemical Society was held on Monday evening last, in the Hall of the Philosophical Society. There was a very large attendance.

The **President**, Professor Thomas Anderson, M.D., F.R.S E., occupied the chair.

After the minutes of the former meeting were read and approved of, and nine new associates proposed and admitted into the Society.

Dr. **Anderson**, in a few introductory remarks, thanked the members for having appointed him to the office of President of a Society of whose future success he felt great confidence. He felt assured that the new Society would have a long career of usefulness, and that its members were very fortunate in having, as the first communication to the Society, the paper to be submitted to their notice that evening, by M. Ludwig Mond, on his remarkable process for the recovery of sulphur from the black-ash waste of the alkali works. The President then called upon

M. **Mond**, who is at present practically putting his process in operation in the alkali department of Messrs. Charles Tennant and Company's Chemical Works, St. Rollox. The paper of M. Mond gave, in clear and intelligible English, an elaborate account of his recovery process from the commencement of his labours. It also referred to the other processes which have been brought under the notice of alkali manufacturers from time to time, to effect the same object, and showed wherein they had failed to meet with the success which had in such a marked degree attended the application of his process. In the outset M. Mond referred to the vast importance of the alkali trade, and characterised the St. Rollox Alkali Works as the most important and interesting of their kind in the world, not only on account of their vastness, but because a very considerable number of the most valuable improvements in the manufacture of alkali and its cognate industries have originated or been first adopted in them. The manufacture of bleaching powder, which has become so extensive that it can hardly be now called a secondary product, was invented by the founder of the firm, Mr. Charles Tennant, and is still carried out in the St. Rollox Works on a larger scale than in any other similar establishment in the world. Among the many other improvements which have first been applied in Messrs. Tennant's Works, M. Mond instanced the now famous apparatus for the lixiviation of black-ash, on which the final success of his process altogether depends, and regarded it as remarkable that the first apparatus ever put up for this purpose is at present employed for his sulphur-recovery process. He then mentioned some rather astonishing details illustrating the great development of the alkali trade in Great Britain within the last four years. In the year 1864 the quantity of common salt decomposed in this country was about 288,000 tons, and it rose to about 400,000 tons in the year 1867, or about 40 per cent. This quantity of salt requires about 320,000 tons of oil of vitriol for its decomposition, and this amount contains nearly 100,000 tons of sulphur. At present the sulphur is nearly all obtained from iron and copper pyrites, which are supplied at a much cheaper rate than brimstone, owing to the successful working of one of the largest mines in Spain, by the Tharsis Mining Company, which has been principally formed amongst Glasgow gentlemen, and especially by the intelligence and perseverance of Mr. William Henderson, who has brought his process of copper extraction from the residual burned ore to an unprecedented pitch of perfection. Notwithstanding the extensive use of pyrites in the vitriol manufacture, Sicily still enjoys a sulphur monopoly, and exports annually a very large quantity of that substance—a quantity which last year amounted to upwards of 200,000 tons, of which about 50,000 tons was consumed in Great Britain. M. Mond considered that by his recovery-process British alkali manufacturers might make themselves independent of Sicily as the source of their sulphur supply, inasmuch as they have a material which has hitherto been a source of inconvenience and outlay to those manufacturers in whose operations it is unavoidably produced, and from which the sulphur can be obtained at a much cheaper rate than that at which it can be imported. He then, in a clear and intelligent manner, described the apparatus in which the process is conducted, the *modus operandi* of the process, and the chemical changes which are involved in it. He also practically illustrated the process in the presence of the members, and produced a very decided quantity of sulphur. A variety of specimens, illustrating the various stages of the process, were shown to the members. (The details are essentially the same as those contained in the paper by M. Mond, which appeared in the Chemical News for 19th and 26th of July of last year. To this paper our readers are referred.) M. Mond regretted very much that the chemistry of the polythionic acids so intimately connected with his process, had hitherto received so little attention from chemists.

At the conclusion of the paper the President congratulated the author on the great success and simplicity of the process which he had given to the alkali manufacturers, and on the interesting manner in which he had brought it under the notice of the Society, and then at some length gave an account of a sulphur-recovery process which he had seen in operation at Dieuze.

Mr. E. C. C. **Stanford** and one or two other gentlemen spoke, but as the time was far advanced there was very little opportunity for discussing M. Mond's interesting and valuable paper. The author was awarded a hearty vote of thanks.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, March 20, 1868.

His Royal Highness the Prince of Wales, K.G., in the Chair.

"*On Alloys and their Uses*," by Professor Augustus Matthiessen, F.R.S.

The object of this discourse was to show experimentally why alloys are used in preference to their component metals.

Alloys may be, chemically considered, divided into three classes:—

1. Chemical combinations.

2. Mechanical mixtures.

3. Solutions of the one metal in the other which have become solid; or, for shortness sake, solidified solutions of the one metal in the other.

Under the term chemical combination such alloys may be considered which are the result of the combination of two metals when these unite together with great energy and evolution of heat, producing an alloy the physical and chemical properties of which we cannot foresee. As an example of such alloys those of gold, with tin, lead, or zinc may be quoted; for if to melted tin, lead, or zinc, gold be added, the two metals unite together with great energy and produce an alloy which is exceedingly brittle and totally unfit for practical purposes.

It is for this reason that the more expensive metals, silver and copper, are used for alloying gold for the purposes of coinage, &c.

With regard to such alloys which may be looked upon as mechanical mixtures, like oil and water, or rather as ether and water, for no two metals are known which, like oil and water, do not dissolve at all in one another, but a few metals are known which, like ether and water, dissolve slightly in one another, for ether will dissolve a certain amount of water, and water a certain amount of ether. If ether and water be mixed together, say in equal parts, two layers will be formed, the top one being ether containing a little water, the lower one water containing a little ether. Two metals, for instance, which behave in exactly a similar manner to ether and water are lead and zinc, for lead when fused with zinc will dissolve 1·6 per cent zinc, and zinc in its turn will take up 1·2 per cent lead.

If these two metals be fused together, say in equal parts, they will separate into two layers, like ether and water, the top one, being the specifically lighter, zinc, with a small percentage of lead, the lower one lead, with a small percentage of zinc. If such an alloy be made and cast in a mould, the difference in the behaviour of the two ends may be easily shown; for the top one is so brittle that it cannot be bent without breaking, whereas the lower one may be bent with ease.

Such chemical combinations and mechanical mixtures are, however, comparatively rare; and for alloys in common use, practice has almost invariably chosen such alloys as may be considered as belonging to the third class, rejecting those of the first and second as worthless for practical purposes.

Under the term solidified solutions of the one metal in the other, such alloys may be considered, which, like the chlorides of potassium and sodium when fused together, produce a mass having some of the physical properties totally different from those of the component salts. It cannot be assumed that the chloride of sodium enters into chemical combination with the chloride of potassium. One important property of a solidified solution is, that the components are homogeneously diffused in one another, so that even under the most powerful microscope they can no longer be distinguished from one another.

Alloys are used because they possess certain physical properties to a far greater extent than their component metals. The physical properties may be divided into two classes.

1. Those which in all cases are imparted to the alloy, approximately in the ratio in which they are possessed by the component metals.

2. Those which in some cases are, and in others are not, imparted to the alloy in the ratio in which they are possessed by the component metals.

To the first belong Specific Gravity, Specific Heat, and Expansion due to heat. It is easy to show this experimentally; the specific gravity of an alloy may be shown to be equal to the means of those of its component metals, by hanging on the one side of a balance the alloy and on the other side the metals composing it unalloyed, and then placing them both in water.

The specific heat of an alloy may be proved equal to that of its components by placing the alloy and its components in boiling water, and then in equal volumes of cold water; when the rise of temperature in the two cases will be found the same, as may be shown by a differential-air thermometer.

A brass bar placed in any apparatus for showing expansion by heat is seen to expand exactly as much as a composite bar, of which one portion is of copper, the other of zinc. The length of the zinc portion being proportional to the amount of zinc in brass.

To the second class of physical properties belong, Conduction for Heat and Electricity, Hardness, Tenacity, &c.

As a basis for the conclusion which will be drawn, the electric conducting power for alloys may be taken. Researches into this subject have shown that when tin, lead, zinc, or cadmium are alloyed together, such alloys conduct electricity in the ratio of the relative volumes of the component metals, whilst in all other cases no such simple relation exists between the conducting power of the metals and their alloys. If, for instance, gold be alloyed with silver, say in equal volumes, the conducting power of an alloy will be 15, that of silver being 100, and that of gold 80.

If curves be drawn to represent the conducting power of different series of alloys, three typical forms will be observed: the first represented by nearly a straight line, the second by the letter *L*, and the third by the letter U.

Wiedemann and Franz have proved experimentally that the values obtained for the conducting power of metals and alloys, for heat and electricity, are identically the same: and the truth of this statement may be shown by the following experiment:—If bars of gold and silver and some gold-silver alloys be fixed so that one end of all of them is in a hot-water box and the other end in the bulb of a small air-thermometer, the depression in the columns of the liquid in the tubes of the air-thermometers will indicate the relative conducting powers (approximately) of the several bars; and if through the tops of the columns of liquid a line be drawn, such line will form a curve similar to that referred to as obtained for the electric conducting power.

That this is true is thus shown:—

By the side of this apparatus is placed another of this construction:—Into the bulbs of several air-thermometers are fixed wires of the same size and length, and of the same materials as were used in the heat-conducting experiment. One end of each wire is soldered to one thick copper wire, and the other end to another similar wire. These two wires are connected to the poles of a battery. The current will then divide itself, and a portion will pass through every wire proportional to the conducting power of that wire. This current will heat the wire and cause the liquid in the tubes connected with the air-thermometers to descend, and the line drawn through the top of the columns will be nearly similar to the curve already mentioned, which is formed by the bulbs in which the heat-conducting bars are fixed.

The analogy between the relation existing in this case and in some others may be shown experimentally as follows:—

Sonority. When bars of alloys and their component metals are struck, a great difference will be found in the note produced; and in almost every case where the experiment has been made, the most sonorous alloy was found to correspond in composition approximately with that at the turning point of the electric conducting power curve.

Tenacity. When wires of the same diameter of metals and alloys are broken by traction, those of the alloys will require a much greater force than their component metals;

and it may be deduced from what is known, that those alloys, the composition of which corresponds to the turning point of the conducting power curve, are more tenacious than any other alloy composed of the same metals.

Elasticity. When spirals of wires of metals and their alloys are weighted to an equal extent, the alloys will be found on removing the weights to possess the property of resuming their original form in a much higher degree than their component metals. Here again the alloys corresponding in composition to those of the turning point of the conducting power curves are the most elastic.

From what has been said, and from the experiments described, the conclusion may be drawn that the chemical composition of the practically-used two-metal alloys correspond to those situated at the turning points of the heat and electric conducting power curves, and that if a two-metal alloy of a special physical property be required, it would be as well to try that alloy, the composition of which would correspond to the turning point of the curve representing the electric conducting power of the alloys of the two metals.

FOREIGN SCIENCE.

Paris, April 6, 1868.

Volumetric method of estimating carbonic acid in natural waters.—Aniline marking ink.—Glaze for crystallising pans.—Preservation of saccharine juice. Academy of Sciences:—Skeletons of cellulose.—New mode of forming organic sulphacids.—Transformation of uric acid into glycocol.—Oxychloride of silicium.

M. Barthélemy, Professor of Physics at the Lycée de Pau, has published a volumetric method of estimating carbonic acid in natural waters. His process depends upon the reaction of the protonitrate of mercury upon the alkaline and earthy carbonates; by means of the same reagent he is enabled to estimate small quantities of acid—for example, the nitric acid present in rain water after a storm. The crystals of neutral protonitrate of mercury are soluble in water, which at the same time decomposes the compound into insoluble sub-nitrate, and acid nitrate which remains in solution. The supernatant liquid, in the presence of mercury, may be kept a long time without undergoing any decomposition. The reagent is prepared by treating mercury with cold dilute nitric acid. Upon adding to a dilute solution of an alkaline or earthy bicarbonate, protonitrate of mercury, a precipitate forms, which is at first white, afterwards orange, and often greenish: this precipitate is soluble in excess of the reagent; also in sulphuric and nitric acids, in urine, and other organic matters.

In a solution of neutral carbonate the same reagent produces a brown precipitate which, when the alkaline carbonate is mixed with bicarbonate, takes a more or less deep green tint; this brown precipitate is insoluble in excess. By passing carbonic acid into the solution, (it is sufficient to breathe through a tube), the reaction indicated for the bicarbonate is produced. The amount of acid nitrate which it is necessary to add for complete precipitation and resolution, is proportional (1) to the quantity of carbonate, (2) to the degree of concentration of the reagent, (3) to the quantity of carbonic acid engaged in the solution. M. Barthélemy prepares his normal solution by dissolving ·5 grm. of bicarbonate of potash (equal to ·241 of carbonic acid), previously heated in a current of dry carbonic acid, in a litre of distilled water. It is necessary before pouring out the solution of nitrate of mercury from the burette to agitate well, since the mercurial solution is very dense. When waters contain chlorine, the determination of the carbonic acid cannot be made exactly. Approximate results may, however, be obtained by acidulating 100 c.c. of the water with nitric acid, decomposing thus the carbonates, and then noticing the number of divisions required to precipitate the chlorides and produce a definite grey tint; afterwards the same given volume of water is treated with the solution of nitrate of mercury, until the yellowish orange first produced has disappeared, and the tint of the chloride alone remains. The first experiment serves as a standard of colour, and the addition of fluid from the burette is arrested, when the tints appear identical.

The process also admits of the separate determination of earthy and alkaline carbonates. By boiling 100 c.c. of water, maintaining the volume by adding distilled water, leaving to deposit, filtering, and passing a current of carbonic acid, matters are arranged for the volumetric determination of the carbonic acid combined with the alkalies; knowing already the amount combined with alkalies and alkaline earths conjointly, there is no difficulty in finding that due to carbonic acid combined with alkaline earths only. Here is another method, and one to which M. Barthélemy gives the preference:—A solution of potash (containing ·5 grm. of potash in a litre of water) is added in definite volume to 100 c.c. of the water; the simple carbonates are deposited on the sides of the vessel. At the end of a few days the solution is decanted and saturated with carbonic acid. The carbonic acid in solution is then determined, and that in the same volume of potash solution saturated with carbonic acid also; the difference between the amounts of solution poured from the burette, in the first experiment and the second, is the amount required by the alkaline carbonates in 100 c.c. of the water.

An indelible marking ink is prepared from aniline by mixing the two following solutions: *a*, cupreous solution—8·52 grm. of crystallised chloride of copper, 10·65 grm. chlorate of soda, and 5·35 grm. of chloride of ammonium are dissolved in 60 grm. of distilled water; *b*, aniline solution—20 grm. of hydrochlorate of aniline are dissolved in 30 grm. of distilled water, and 20 grm. of a solution of gum arabic (1 of gum to 2 of water) with 10 grm. of glycerine are added. By mixing in the cold four parts of the aniline solution with one part of the cupreous solution, a green liquid is obtained which can be used immediately for tracing characters upon linen; the marks, however, alter after the lapse of a few days. It is necessary to keep the solutions separate until required for use. If the fluid does not flow easily from the pen, it may be diluted without fear of diminishing the intensity of the tint, which at first green, gradually darkens and becomes black. Heat causes the change to take place instantaneously; a steam heat is sufficient, and is better for the fabric than a hot iron. Afterwards the linen is washed in warm soap and water. This ink resists acids and alkalies, and is remarkably permanent.

Some remarks upon the glaze of vessels used for crystallising in chemical works, have been published by M. Stinde. By his experience, the majority of glazes proposed for iron vessels do not fulfil their purpose well, either they become detached, or traversed by rust when the vessel remains empty for a few days. The mixture of oxide of zinc and soluble glass adheres to the iron well enough, but it does not prevent rust. Of all materials proposed, that of a mixture of oil and minium of iron (peroxide of iron mixed with alumina) is unquestionably entitled to preference.

After having thoroughly pulverised the minium, it is mixed with linseed oil, rendered pasty with manganese. This mixture is applied to the iron surfaces carefully cleaned, and deprived of rust by means of pumice-stone.

MM. Périer, Possoz, Cail & Co. have patented a process for the preservation of saccharine juices. Lime, it would appear, has been long known as a preservative substance; in applying it directly to the saccharine juices of plants, saccharate of lime is formed, and this can be preserved unaltered for a great length of time. Upon decomposing the compound, however, for the recovery of the sugar, it is found that the foreign matters existing in the juice have undergone such changes as to impede the extraction and crystallisation of the sugar. The patentees of the present process propose therefore to apply the lime no longer to the juice of the plant, but to the juice after removal of the foreign matters. They consider also that the lime ought to be employed in larger proportion than it has been heretofore. While M. Kuhlmann, in 1833, indicated as sufficient for the raw juice, ·3 to ·5 per cent, they consider 1 per cent necessary for the purified juice, and when required to be preserved during some months, 2 per cent, the density of the juice being ·1040.

The memoirs relating to chemistry, brought before the Academy of Sciences at the meeting on the 16th of March, were the following:—"On a tissue or skeleton of cellulose, directly extracted from an epidermis," by M. Payen. "On a meteorite which fell on the 9th June, 1867, in Algeria," by M. Daubrée. "On a new mode of formation of organic sulphacids, and on the transformation of uric acid into glycocol," by M. Strecker. "On an oxychloride of silicium." "The reduction of nitrates and sulphates in certain fermentations," by M. Béchamp. "On the cultivation of beet-root for sugar," by M. Mehais. M. Maumené addressed some observations on the subject of potash extracted from suint.

M. Payen referred, in commencing, to the numerous examples of vegetable substances he had made known, in former researches, where the skeletons of cellulose at first are easily obtained, and where the cellulosic substance is possessed of the properties as well the composition of cellulose, and yet afterwards, during growth, foreign matters mask these properties. When nitrogenous matters fatty and saline, have thoroughly penetrated the cells, the difficulty experienced in separating them is so great that some have considered the mixture of substances free from cellulose, and have in fact believed in the presence of an entirely new proximate principle. M. Payen in very cold weather submitted several tubercles of potato to refrigeration. After thawing, the epidermis was easily removed. By careful treatment with various acids and potash solution, during many days, as well as by washing with water, alcohol, and ether, the membranous substance was obtained in a supple condition and white: specimens were exhibited to the Academy. The substance thus purified gave the reaction—the blue tint with a very weak solution of iodine when acidified with sulphuric acid—due to cellulose.

M. Strecker's method of forming organic sulphacids consists in reacting upon the chlorides of the radicals with sulphites. Several compounds of the sulphacids have been obtained in M. Strecker's laboratory. Iodide of methyl heated to 150° with a solution of sulphite of soda, yielded methylsulphite of sodium (methyl-d thionate), according to the equation

$$CH_3I + Na_2SO_3 = CH_3SO_3Na + NaI.$$

Bromide of ethylene and sulphite of potash gave disulphethylenate of soda and bromide of potassium. A new acid, which may be called trisulphoglycerilic acid, is produced when trichlorhydrine is reacted upon by sulphite of potash

$$C_3H_5Cl_3 + 3K_2SO_3 = C_3H_5(SO_3K)3 + 3KCl.$$

The chlorinated acids comport themselves in an analogous manner; monochloracetic acid is transformed by ebullition with a solution of an alkaline sulphite into alkaline sulphacetate. The chlorhydrate of oxide of ethylen furnishes, under the same conditions, isethionic acid. M. Strecker states that all the chlorine, bromine, and iodine, directly united to the carbon, is usually replaced by an equivalent quantity of the radical (SO_3K). At the same time it often happens that only a portion is replaced, while the rest remains unattacked. In heating chloroform with a solution of sulphite of potash, the potash salt of sulphodichloromethylic acid was obtained, according to the equation, $CHCl_3 + K_2SO_3 = CHCl_2SO_3K + KCl$. M. Strecker remarked that his experiments showed that the sulphacids contained the residue SO_3H united directly to the carbon by the sulphur; he thought it probable that the isomeric ethyl-sulphurous acids contained likewise this group, but united to the carbon by the interposition of oxygen.

M. Wurtz presented the foregoing, as well as another note by M. Strecker, "on the transformation of uric acid into glycol." When uric acid is heated with a concentrated solution of hydrochloric acid, or hydriodic acid, preferably the latter, in a sealed tube, to a temperature of 160-170°, it is completely transformed into glycol, carbonic acid, and ammonia. Upon opening the cold tube, a continuous current of carbonic acid is seen to be disengaged. The solution, treated with hydrated oxide of lead, evolves abundance of ammonia, and after removal of the lead by sulphuretted hydrogen yields, upon evaporation, a crystalline residue of glycol. Analysis showed the substance to be identical with that obtained from hippuric acid; the crystalline form and the chemical properties were also in perfect accordance. If, then, hippuric acid be considered as a glycol joined to benzoic acid, uric acid may, in the same way, be figured as a combination of glycol with cyanuric acid; these two acids, characteristic of the urinary secretions of herbivorous and carnivorous animals, are now seen to present more resemblance than could have been supposed.

MM. Friedel and Ladenburg have observed that in passing chloride of silicum through an empty porcelain tube, or one filled with fragments of felspar, heated to a temperature approaching the point of fusion for this mineral, and distilling, the product condensed at the extremity of the apparatus, is a liquid less volatile than the chloride. By repeating the operation a great number of times with the more volatile portions, a notable amount of a liquid boiling above 70° is obtained. This product submitted to fractional distillation is easily separated into chloride of silicium and a liquid chiefly boiling between 136° and 139°. Limpid and fuming in the air, this liquid bears great resemblance to chloride of silicium; it is likewise decomposed by water energetically. Analyses were made by introducing weighed bulbs, full of the liquid, into flasks containing a certain quantity of water; breaking the bulbs afterwards, almost the whole of the silica, when sufficient water was present, remained in solution. The acid liquid, saturated with ammonia, was evaporated on the water-bath; the residue dissolved in water and filtered gave on the one side silica mixed with the glass of the bulb, on the other a solution in which the chlorine was determined. The numbers obtained lead to the formula Si_2OCl_6, from which the new body is seen to be an oxychloride of silicium.

NOTICES OF BOOKS.

Chemical Notes for the Lecture-room On Heat. By Thomas Wood, Ph.D., F.C.S. London: Longmans & Co.

It is a pleasure for us to record that this text bock has met with the success that we predicted for it. As a consequence a second edition has been published in a comparatively short space of time, and Dr. Wood has by careful revision considerably improved it. As we could never attach any very clear or definite meaning to the word "*cram*," as applied to tuition, we forbear to discuss in what way such an expression could attach itself to a work like that under notice. It is, however, within the experience of every observer that cramming, in teaching, not unfrequently is used as synonymous with method, conciseness, and want of verbiage, by persons whom we presume have never followed such a highly reprehensible course.

An expression which *is* definite may convey clearly the avowed object of this book, which is one that we may boldly say is a legitimate—even more, a desirable one—

and that is *drill*. Many minds require the same fact to be placed before them over and over again in the same light and in the same words; but this is not equivalent to saying that such a *drilling* is applicable to leading and superior minds in which originality is to be hoped for. Dr. Wood certainly can with justice claim to have carried out thoroughly a plan that he has clearly sketched out for himself, and this we take to be no small merit in a writer of science. The majority of our readers will we think acknowledge the justice and truth of what Dr. Wood asserts in his preface.

"Many years' experience in teaching has convinced me that the average boy can only be provided with a very limited amount of producible information on any subject for an examination. A small book, therefore, with which he may become so familiar as to be able to refer to it with ease and rapidity, and which he can almost get by heart, is the thing required, and the present edition is offered as such."

In the next edition we would suggest that the author should properly punctuate the title of his book. Many who have not had the advantage of Dr. Wood's explanation might be puzzled to know the meaning of a "Lecture-room On Heat."

Scientific Blue Books. No. I. *Abridgments of Specifications of Patents.*

It may be urged with justice, we are afraid, that scientific men in general, with the exception perhaps of authors, are totally ignorant of the fact that there exist scientific blue books, the value of which is very great, as by consulting such we invariably get evidence the accuracy of which no one can fairly dispute. Thousands of valuable scientific blue books are destroyed as waste-paper, owing mainly to the want of appreciation by the scientific public.

The original books of specifications of patents are far too costly and cumbersome for any but a large public library; thus the specification of patents filed during the operation of the Patent Law Amendment Act, from Oct. 1st, 1852, to June 30th, 1866, are comprised in 43,955 blue books, or 1,428 thick volumes imperial octavo, to be obtained at a price of £1,290.

The very first idea that is impressed upon the mind by this really impressive, not to say oppressive, fact, is that some of all this mass of matter must be of value; and if this value exists, the papers would be well worth wading through once and for ever by competent authorities, with the view of sifting the grain from the chaff in the first place, and in the second of converting that grain into material that may be easily digested. The second of these processes is continually being carried on by authors of technological works in every department of science; but the short digest of cumbersome works is not so well adapted to the needs of these, as to the students of such works who may desire to have authentic records of any technological process which may in turn serve as a reference to a still more detailed description if such be necessary. This work is now being conscientiously and thoroughly done in a systematic manner, and we are only discharging an obvious duty in doing the utmost in our power to prevent a premature close to a good project.

The abridgements of specifications of patented inventions carefully classified are miniature blue books, of duodecimo size; each affords at once a chronological, alphabetical, subject-matter, and reference index to each class, the work being done by well qualified compilers; omissions that are wholly unavoidable from the mass of the material will be supplied in second editions. In addition we find an introduction to each volume, which further gives a short digest of the various discoveries made from time to time in each branch. The prices of these works are extremely moderate, and a copy of the more important ones should be possessed by all practical chemists who devote themselves to the various branches of technology. At present twenty-nine classes have been published, and among those of more immediate interest are those of "Preservation of Food," "Manufacture of Iron and Steel," "Bleaching, Dyeing, and Printing," "Electricity and Magnetism; their Generation and Applications," "Production and Applications of Gas," "Metals and Alloys," "Photography," "Plating and Coating of Metals," "Oils, Animal, Vegetable, and Mineral." The following we learn with numerous others are in course of preparation: "Preparation and Combustion of Fuel," "Steam Engines," "Stone, Marble, and Cements," "Acids, Alkalies, Oxides, and Salts."

If due appreciation attend these efforts, doubtless others will appear in course of time. Valuable as these abridgements are to all scientific men, they will prove to be invaluable to those who desire to know what processes really are patented and what are not. We would urge upon the authorities, however, that as these volumes bear evidence of great industry, considerable powers of accuracy, and require the rather rare quality of condensation with judgment, and without important omissions on the part of the compiler, it would only be a matter of justice to give the credit due to the author, in every case, by appending his name as such. The practice of working by deputy is only to be encouraged when the said deputy is exposed to a just criticism of his own share in the work, which criticism should be limited to such personal work. By a subdivision of labour, again, it so frequently happens that any responsibility is easily lost sight of, and inaccuracy is a frequent result.

We are told by Mr. Woodcroft that the most recent chemical names of substances are placed in italics after the names that have been obtained from the respective specifications; "this addition is rendered necessary by the universal adoption of the new chemical nomenclature."

We hope that this addition will not at present be made to the substance of the specifications themselves; even the most ardent radical in chemistry would not care to have a string of synonyms after every mention of such a substance as, say, calomel, which, if burdened with aliases, after the manner of legal definitions, would, we are afraid, present a very criminal appearance indeed.

CORRESPONDENCE.

WATER-TESTS.

To the Editor of the Chemical News.

Sir,—Your correspondent, Mr. J. Muter, gives me the credit of having published, through the medium of the *Times*, an extemporary method of recognising pollution in water by the sense of smell. Mr. Muter has misread the letter to which he alludes. I merely reminded the country householder that he usually contented himself with a glance and a sniff at his water-bottle, and suggested that eyes and nose would be better detectives if he previously well shook the water or even placed it in a warm place for a few hours. Mr. Muter's letter to you is similar to one he sent the previous week to the *Medical Times and Gazette*; the sentences in which I am mentioned are word for word the same. In answer to that letter a kind friend has replied, this week, as follows,—I am, &c.,

John Attfield.

Testing Water for Organic Impurities.

Sir,—In connection with remarks on "country wells," Professor Attfield simply stated, in his letter to the *Times*, that "polluted water does not generally betray its condition till possessed of a strong odour; earlier intimation may, however, be obtained by the following tests:—Half fill a common water-bottle, cover its mouth with the hand, violently shake for a minute, and quickly apply the nose. If nothing unpleasant is detected, tightly cork the bottle, set it aside in a warm place at about the temperature of one's body for a couple or three days, and repeat the shaking, &c. Water of very bad quality may thus be recognised without the trouble and expense of analysis." Of course householders would get still earlier intimation, or else the comforting assurance that the water contained no organic impurity, by seeking professional assistance; but such a statement by an analyst in a leading newspaper would have been scarcely ethical. I have found Professor Attfield's hints of very great use, and am convinced that few persons besides your correspondent, Mr. J. B. Muter, could possibly have received from them the impression that any water free from odour is fit to drink, —I am, &c.,

Sanitas.

ROYAL SCHOOL OF MINES.

To the Editor of the Chemical News.

Sir.—Will you kindly allow me to draw attention to one question which appears to have escaped notice, viz—What is the meaning of the designation Royal School of Mines?

The term R. Mining School, or School for Miners, I could understand; but this one I cannot. I know what a school of boys is, and I have heard of a school of whales, but what is a School of Mines? It is true that there exists an Ecole des Mines, but I do not know why our corresponding institution should bear a name which is a literal translation of the above title.

Now that the School is just beginning to be known, it seems almost a pity to propose any alteration, still I really believe that it would be preferable to call it the "College of Science," as suggested by "Delta," than to let it still retain its present inappropriate and absurd name, more especially as only a small fraction of the students ever have anything to do with mines or mining in after life.

My apology for again encroaching upon your valuable space must be the deep interest which I take in the Institution and everything connected with it.—I am, &c.

A. L. E.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Isomerism of the Hydrocarbons C_2H_{10} and C_4H_8.—A. Butlerow. There can be only two isomers of the composition C_4H_{10}; the one is ethyle

$$\left\{\begin{matrix}CH_2(CH_3)\\CH_2(CH_3)\end{matrix}\right.$$

the other trimethylformene $C(CH_3)_3H$, obtained by the author from trimethylcarbinol (tertiary pseudo-butylic alcohol) by the action of zinc on trimethylcarbinylic iodide. The reactions of the two compounds prove them to be isomeric, not identical. The action of chlorine, for instance, gives rise to the formation of oily products, of which that derived from trimethylformene is lighter than water, that from ethyle heavier; and on heating those chloro-derivatives with water to 100° C. trimethylcarbinol is formed in the one case, and scarcely any action is observed in the other.

The number of isomeric butylenes according to the author is nine; that derived from trimethylcarbinol by the action upon it (its iodide) of alcoholic potassic hydrate, has the formula,

$$C\left\{\begin{matrix}(CH_3)_2\\CH_2\end{matrix}\right.$$

and is converted into pseudopropylcarbinol (primary pseudobutylic alcohol) on oxidation with hypochlorous acid.—(*Ann. Chem. Pharm.* cxliv. 1.)

Synthesis of Alcohols.—E. Linemann. The synthesis of fatty alcohols from the lower members of the series by way of successive conversions of the alcohol (methylic) into cyanide, amide of next higher alcohol, and alcohol, is of little practical value on account of the great loss experienced in the last stage of the process. The conversion of the amide into alcohol by means of an excess of nitrous acid (Hofmann), whereby nitrite of alcohol is produced, is accompanied by a rapid evolution of nitrogen which carries of most off the volatile alcoholic nitrite. The author has discovered a process by which more than one-fourth of the amide is obtained as alcohol. It consists in boiling the nitrite of the amide with slightly acidulated water, whereby its splits up into nitrogen and alcohol, the alcohol being prevented from evaporation by the water present. The conversion of the amide into nitrite is effected by decomposing its chlorhydrate with argentic nitrite. A. Siersch by means of this method converted ethylic alcohol into isopropylic alcohol.—*Ibid.* cxliv. 129. 137.

Stannic Diethyl-dimethyle.—N. Morgunoff. Methyl-caproyl and acetyl-amyle, $C_7H_{14}O$, according to Popoff's experiments are identical, which fact proves the equality of the four carbon affinities. Morgunoff has from the same point of view examined the two stannic diethyl-dimethyle

$$Sn\left\{\begin{matrix}(CH_3)_2\\(C_2H_5)_2\end{matrix}\right.$$

as obtained either by acting upon stanndiethylic diiodide with zincic methide or upon stanndiethylic diiodide with zincic ethide, and he has found that both methods lead to the same result, and that therefore the four affinities of the tetratomic tin, like those of carbon, are of equal value.—*Ibid.* cxliv., 157.

MISCELLANEOUS.

Sir David Brewster's Last Words.—Sir J. Simpson says:—"It seems to me that I carry almost a mission from him to us—from the dead to the living; for when I last visited him at Allerly, when he was within a few hours of death, when he was already pulseless, his mind was perfectly entire, and perfectly composed; and on asking him, among other matters, if he wished any particular scientific friend to take charge of his remaining scientific papers and notes, he answered me, 'No; I have done what every scientific man should do—viz., published almost all my observations, of any value, just as they have occurred."

A Model Scientific Writer.—Professor Fraser says with regard to Sir David Brewster's great precision, energy, and determination of thought—that during the seven years that he (Professor Fraser) was editor of the *North British Review*, Sir David Brewster contributed an article to every number; and that he did far more—that he stated the day when his first slip of paper would come, and the day when it would be finished. His manuscripts came as they were written—day after day, and sheet after sheet—and without the necessity of the revisal of those preceding. He thus worked with the precision and regularity of a mechanical rather than a mental machine.—*Scientific Review.*

M. Panizzi and Men of Science.—In a letter to the *Times*, defending a statement made in Parliament that Mr. Panizzi, principal librarian of the British Museum, "had not scrupled to express his contempt for men of science," Mr. W. H. Gregory, M.P., writes:—"Three short passages from Mr. Panizzi's evidence before the select committee on the British Museum in 1836 will prove the correctness of my expressions. In answer 4,929 Mr. Panizzi gives his opinion of scientific men in these words:—'Scientific men are jealous of their authority; they are dogmatical and narrow-minded, and as they think themselves infallible they would never consult an officer. I speak from what I have known of them.' '4,930. The scientific men would spoil the men of rank or drive them away from the Board. I speak seriously, and from experience. An officer would have no chance against a scientific man who should take a crotchet, and they are all crotchety.' '4,933. I never saw scientific men go right or view things as other people do. I think the trustees would be much better without them.'"

Chemical Nomenclature.—M. Dumas, the new secretary of the Académie des Sciences, observes:—"If every one of us took the fancy of combining with his name that of his great-grandfather, of his grandfather, of his father, and his mother, a singular complication would be found in our registers of births. A lifetime would be passed in learning the names of the persons with whom we were acquainted in our own neighbourhood. As to knowing the names of the inhabitants of a town, that would be an utter impossibility. This is, however, what our *savants* who pursue organic chemistry have to accomplish, so that their language has now arrived at a point of barbarism that cannot be surpassed. Now, would it not be desirable, in all points of view, to adopt a generic word, and to group around such word the names of species in proportion as science extends her conquests? I am particularly interested in organic chemistry, but I declare that time is entirely wanting to me to peruse, while comprehending them, the various memoirs on the science which come under my notice. The complication and insupportable length of the names employed are the sole causes of this."—*Medical Times and Gazette*, March 21st.

Rattlesnake Poison.—The following are the conclusions at which Dr. Weir Mitchell has arrived:—1. One-fourth of a drop of the venom is fatal to pigeons under the age of four months. One-eighth of a drop is frequently a fatal dose. 2. The venom is absolutely harmless when swallowed, because (*a*) it is incapable of passing through the mucous surfaces; (*b*) it undergoes change during digestion, which allows it to enter the the blood as a harmless substance, or to escape from the canal in an equally innocent form. 3. Twenty-four hours after it has been swallowed, the contents of the bowel contain no poison. 4. The rectum of the pigeon does not absorb the venom, and it causes no injury when placed on the conjunctiva of animals. 5. The venom passes through the membranes of the brain, and more swiftly through the peritoneum and pericardium. 6. When the venom passes through the peritoneum it so affects the walls of the capillaries as to allow of their rupture and of the consequent escape of blood. The same phenomena appear on the bare surface of muscles thus poisoned. This, together with the defect of the coagulability of the poisoned blood, accounts for the excessive hæmorrhage about the fang wounds. 7. The blood globules are unaltered in venom poisoning. 8. The rattlesnake is not susceptible of injury by the venom of its own species. 9. The sulphites or hyposulphites of soda or lime have no antidotal power. 10. Carbolic acid sometimes delays the fatal result, and usually lessens local hæmorrhage. 11. These effects are due to no influence of the acid on the venom, but to a direct effect upon the local circulation of the envenomed part. 12. Carbolic acid has no value as true antidote, and when given internally does not affect the ordinary fatal issue.—*New York Medical Journal.*

Steel Billiard Balls.—Among other new uses of steel, one of the latest is that of the employment of this metal for billiard balls instead of ivory. They are very elastic, and are not liable to crack like those in present use.

Important to Chemists.—This advertisement appears in a Paris paper: "A young lady of forty-eight, having a moderate income, but possessing a patent for a new invention, wishes to marry a gentleman of sixty-five well versed in chemistry."

Stopper Cord.—Stopper cord consists of conical rolls of very elastic rubber, about 4 feet in length, and varying in diameter from one-half an inch at one end to an inch and a half at the other. Stoppers of any diameter between these limits may be cut from the roll and bored with a common brass cock borer, which must be moistened with water to prevent adhesion to the rubber. The stoppers are found to be air-tight under the pressure of 15 lbs. to the inch, provided the contact between the tube and stopper is at least half an inch in length.

The Rusting of Iron.—Perfectly pure water will not rust iron until it is heated to redness, when the contact with the metal instantly forms a red crust. Water oxidises iron more rapidly when it receives small quantities of mineral acids, while on the other hand an alkali or caustic lime destroys the oxidising faculty of water, a fact which is easily explained when we consider what strong affinity carbonic acid has for those bases. We are indebted to Fayen for the determination of the limits of this veto power which alkalies possess over the oxidation of iron in water. He ascertained that a saturated solution of potassa lye diluted with from 1,000 to 2,000 parts of water could still protect iron, but not when diluted with from 3,000 to 4,000 parts. Saturated lime water, when diluted three times, protected iron, but not when diluted four times. Saturated carbonate of soda, diluted with from fifty to fifty-four volumes, protected iron, but not so when diluted with even fifty-nine volumes. The finest cast steel was protected perfectly by even less potash. Rust is porous, and like all porous bodies, absorbs gases. White pig metal scarcely oxidises; grey iron with more facility, bar iron still easier, especially when red hot. Cold-short iron rusts least and slowest. Polish is the best preventive of rust, particularly when the article is kept in dry air.—*Scientific American.*

To Make Plaster of Paris Harder.—With one exception, all admixtures impair the hardness of the plaster. The exception is iron filings. When these are mixed with plaster they rapidly oxidise, and the coherent mass of oxide of iron formed, adds its own strength to that of the plaster, making a very firm mass, which has also the advantage of strongly uniting itself to surfaces of iron. I have not observed what proportion of the filings is best, but suppose they should form about one-fifth the whole weight.—F. Bowly.

NOTES AND QUERIES.

Safflower.—This material contains, in its natural condition, two colouring substances, one insoluble in water, known as carthamin, the pink dye; the other, soluble in water, a yellow colouring matter. In order to obtain the pink dye, it is in the first place requisite that the safflower should be as free as possible from immixtures, as, for instance, seeds, the leaves of the plant, or other flowers, hay, straw, and similar substances. The carthamin is obtained in the following manner:—Safflower is exhausted with a very weak solution of carbonate of soda; in this solution pieces of cotton wool are placed, and the alkali is next neutralised by dilute acetic, or sulphuric acid; the cotton wool thus becomes pink dyed, and the dye is removed from it again by means of weak solution of carbonate of soda, which solution, after the removal, of course, of the cotton, which has given up its colour, is neutralised by means of a dilute acid; a precipitate thus ensues, which is the carthamin; this may be purified by repeating the last treatment. The pink dye thus obtained is very beautiful, and especially applied to silk; only the dye is one of the most fugitive known. Repeatedly purified carthamin, mixed with French chalk, is often used by women to colour their cheeks.

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A NEW PRECIPITANT FOR POTASH, &c.

RESEARCHES ON THE COMBINATIONS OF

MOLYBDIC ACID WITH PHOSPHORIC ACID.[*]

By M. H. DEBRAY.

At the beginning of this century, after Berzelius had determined by numerous and delicate analyses the composition of most of the then known mineral substances, chemists were struck with the simplicity with which their composition could be expressed by means of the proportional numbers given by his researches. This character of remarkable simplicity to which we have now been long habituated, appeared to distinguish Mineral from Organic Chemistry, in which complicated formulæ consequent upon the infinite variety of bodies formed from a small number of elements are the general rule.

The distinction is disputed by most of the eminent chemists of the present day. There is indeed no essential difference between the reactions of organic and those of inorganic chemistry, neither have the compounds in the latter that degree of simplicity which some like to attribute to them.

The discovery of the silico-tungstic acids and their salts, by M. Marignac, has recently furnished a very remarkable illustration of a series of bodies of very complex composition, and yet possessing a sharpness of reactions and a beauty of crystalline form at least as great as the simple products of our laboratories. The study of the combinations of phosphoric and molybdic acids has led me to the discovery of bodies of the same order, of a still more complicated composition, but as well defined and as perfectly crystallised as the compounds of silico-tungstic acid.

I. It is known that the solution of molybdate of ammonia in nitric acid possesses the property of precipitating ordinary phosphoric acid, giving a yellow body almost insoluble in all acids. This precipitate contains about 89 per cent of molybdic acid, a little over 4 per cent of phosphoric acid, the rest being ammonia and water. Upon boiling this in an excess of *aqua regia*, the ammonia is destroyed, and a yellow liquid obtained which yields by spontaneous evaporation beautiful doubly oblique prisms of a yellow colour, which consist of a combination of one equivalent of anhydrous phosphoric acid with twenty equivalents of anhydrous molybdic acid, and a certain quantity of water, corresponding to 13·3 per cent of the weight of the hydrate.[†]

These crystals, very soluble in water, can form two other hydrates; the one containing 23·4 per cent of water, that is to say, double that contained in the first for the same quantity of anhydrous acid; the other only 19·6 per cent. The hydrate with 23·4 per cent is obtained by the spontaneous evaporation of aqueous solutions of phosphomolybdic acid in large regular octohedra; the hydrate with 19·6 per cent is deposited from concentrated solutions strongly charged with nitric acid; these crystals, less beautiful and stable than the preceding, belong to the rhombohedral system.

The small quantity of phosphoric acid which unites in these compounds with molybdic acid (3·7 to 4·1 per cent) suffices to modify profoundly its properties. True molybdic acid may give a soluble hydrate which was first isolated by Mr. T. Graham in the dialysis of acid solutions of molybdates, and more recently by M. Ullik from molybdate of baryta and sulphuric acid,[‡] but this hydrate gives colourless solutions and is uncrystallisable, while the hydrates of phosphomolybdic acid are yellow and easily crystallisable. Moreover, the reactions of this acid differ essentially from those of molybdic and phosphoric acid: Thus whilst all molybdates are soluble in acids, we find that phosphomolybdic acid precipitates from their strongly acid solutions, potash, the oxides of rubidium, cœsium and thallium, ammonia and the nitrogenous organic alkaloids. Soda and lithia, which give no precipitate under these conditions, separate themselves by this reaction, as by many others, from potash and its congeners, whilst thallium approaches it in a decided manner.

The metallic oxides are not precipitated by phosphomolybdic acid in a sufficiently acid solution.[‖] Oxide of bismuth is not an exception, although it forms with phosphoric acid a compound almost insoluble in nitric acid, as M. Chancel has shown; moreover, the mixture evaporated deposits crystals of phosphomolybdic acid in the acid solution of bismuth.

If it is demonstrated that a well-defined body can result from the combination of one equivalent of one substance with twenty of another, there is no reason why there may not some day be discovered still more complex combinations. It will, therefore, be important to examine if the substances which we constantly find, in minute quantity it is true, in a great number of minerals, do not form an integral part of those minerals, the same as more abundant substances, and do not communicate to them special characters. This fact, demonstrated as far as the association of fluorine and chlorine with phosphates, may extend to many other combinations. I may be permitted to remark that if there exist definite combinations of iron and carbon, it will not be necessary to imagine a relation very different to that governing the combination of molybdic acid with phosphoric acid, to obtain bodies having nearly the composition of iron and steel. Thus the compound CFe_{30} would contain only 0·72 per cent of carbon ($Fe=28$, $C=6$.)

II. The composition of the yellow phosphomolybdates of potash, thallium, and ammonium, obtained by precipitating these bases in acid solutions, may be represented by the general formula,

$$3RO, PO_5, 20MO_3;$$

the salts of potash and ammonia also contain 3 equivalents of water of hydration.

These are well-defined compounds, and not mixtures, for it is easy to obtain them crystallised. It is sufficient to fuse, at a dull red heat, the salts of potassium and thallium, to obtain an oily liquid, solidifying on cooling to a mass of crystals; in the thallium salt these crystals are sufficiently distinct and brilliant to admit of the hexagonal pyramid which terminates them being distinguished with the naked eye. A few grammes of material are sufficient for these experiments.

The ammoniacal salt is obtained in small yellow brilliant crystals by mixing two solutions of pyrophosphate of soda and acid molybdate of ammonia; the precipitate is produced slowly in consequence of the transformation of the pyrophosphoric acid into ordinary phosphoric acid under the influence of the acid liquid.

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[*] This memoir, recently read before the French Academy, appears so important that we have decided to give it uncondensed, notwithstanding its length and the numerous demands upon our space at this season.—Ed. C. N.

[†] I have already pointed out this reaction in a former paper on Molybdenum (*Comptes Rendus*, xlvi., 1098), but I did not continue the study of these bodies, not having then a convenient method of analysis.

[‡] Ann. d. Chem. u. Pharm., cxliv., 204.

[‖] I have already shown this property of phosphomolybic acid to the Chemical Society of Paris (*Bull. de la Soc. Chim.*, 2, v., 405), but without studying the compounds so formed. Long before my researches M. Sonnenschein had pointed out for the precipitation of organic alkaloids, a reagent obtained by treating with an excess of soda the precipitate of phosphomolybdate of ammonia, to drive off the ammonia, and dissolving the residue in nitric acid; it is now clear that this reagent is nothing more than a salt of phosphomolybdic acid, which behaves like the acid itself.

A solution of phosphomolybdic acid precipitates neutral nitrate of silver. The precipitate gradually changes to microscopic crystals, the composition of which may be represented by the formula:—

$$7AgO, PO_5, 20MO_3+24HO.$$

This salt dissolves in dilute nitric acid, and the liquid on evaporation furnishes small yellow brilliant crystals of a salt containing two equivalents of base,

$$2AgO, PO_5, 20MO_3+7HO.$$

III. Phosphomolybdic acid and its salts are only stable in the presence of acids; alkalies generally change them into ordinary molybdates and into phosphomolybdates, in which the two acids are united in the more simple proportion of 1 to 5,

$$(PO_5, 20MO_3)+Aq=PO_5, 5MO_3, Aq+15MO_3.$$

These phosphomolybdates are colourless or nearly so, and have a pearly appearance; they are soluble in water and easily crystallisable; an excess of acid reconverts them to the state of yellow phosphomolybdates, setting phosphoric acid free,

$$4(PO_5, 5MO_3)+Aq=3(PO_5, 3HO)+PO_5, 20MO_3+Aq.$$

I give below the formulæ of some of the beautiful salts of this new class of phosphomolybdates:—

Ammonia salt	$6(NH_4O)$,	$2PO_5, 10MO_3 + 14HO$,
Potash ,,	$6KO$,	$2PO_5, 10MO_3 + 14HO$,
Soda ,,	$6NaO$,	$2PO_5, 10MO_3 + 28HO$,
Silver ,,	$6AgO$,	$2PO_5, 10MO_3 + 14HO$.

It would appear that these formulæ could be simplified by dividing all the terms by two, but as the action of acids furnishes a fresh type of salts equally well crystallised, represented by the general formula,

$$5RO, 2PO_5, 10MO_3 + Aq,$$

it is preferable to retain for the first salts the formulæ assigned to them.

Some of these salts may also form double salts with nitrates: I give one of these compounds:—

$$[6(KO, NO_5) + 6KO, 2PO_5, 10MO_3] + 18HO.$$

The facility with which the phosphomolybdic acid giving white salts changes into yellow phosphomolybdic acid and phosphoric acid, has prevented me hitherto isolating it.

IV. The analysis of the preceding compounds presents very great difficulties when recourse is had to the hitherto known methods of separating the bodies composing them. I have used to effect this object two new processes which deserve notice, as they are susceptible of generalisation.

Separate the phosphoric acid from the molybdic acid by passing over a mixture of phosphomolybdic acid and lime, heated to incipient redness in a porcelain boat, first a current of sulphuretted hydrogen, then of hydrochloric acid. There are formed chloride of calcium, sulphide of molybdenum crystallised like the native sulphide, and chlorophosphate of lime, or apatite, also crystallised. The chloride of calcium is removed by water, and the apatite by hydrochloric acid, which does not attack the sulphide of molybdenum; the latter being easy to wash and collect, is carefully weighed. The phosphoric acid is easily estimated in the hydrochloric solution.

When alkaline phosphomolybdates are under examination, a portion of the alkali transformed into chloride volatilises at the high temperature of the operation in the gaseous current; to estimate the alkali recourse must be had to the following process:—Dissolve the phosphomolybdate in excess of ammonia, and add to the solution ammoniacal nitrate of silver; on ebullition crystallised tribasic phosphate of silver is first obtained, and then colourless molybdate of silver equally crystallised; the alkali remains in the liquid, where it is easy to determine it.

ON THE
FORMATION OF DOUBLE SULPHOCYANIDES OF CERTAIN OF THE ALKALOIDS, &c.
(CONTINUATION.)

By WILLIAM SKEY,
Analyst to the Geological Survey of New Zealand.

Since my last communication I have found that platinum, gold, iron, tungsten, and chromium should be added to the list of metals capable of forming insoluble double sulphocyanides with the alkaloids generally and sulphocyanogen, and others no doubt remain to be added, especially from the platinum group.

Annexed are short descriptions of some of the more characteristic of these salts—

Sulphocyanide of Platinum and Morphia precipitates as a red oily looking transparent substance, when a solution of ammonio-bichloride of platinum is brought in contact with a mixed solution of a salt of morphia, and a soluble sulphocyanide; it does not give any reaction of sulphocyanogen with the perchloride of iron, except it is first decomposed by an alkali. If quina is substituted for morphia a yellow crystalline precipitate falls, which melts at a temperature under 200° F. to a yellow oil. The nicotina salt with platinum is a dark red crystalline substance, which as in the case of the morphia salt has to be decomposd by an alkali before the sulphocyanogen reveals its presence by the iron test.

Sulphocyanide of Gold and Atropia, obtained by adding an atropia salt to a solution of sulphocyanide of gold in sulphocyanide of potassium, forms semi-spherical red oily looking drops, adherent to the vessel's sides; at a temperature under 212° they agglomerate to a viscid substance.

The Quina Salt with Gold appears as granular crystals, adherent to enclosing vessel. A morphia salt gives no precipitate with this solution of gold.

Sulphocyanide of Iron and Nicotina is an oil at common temperatures, blood red by transmitted, and green by reflected light; its lustre is metallic.

The morphia and quina compounds with iron are plastic and adhesive at common temperature, while veratria yields pale red crystals, readily soluble in water, the other salts of iron mentioned being but slightly soluble.

Sulphocyanide of Tungsten and Quina falls as a gelatinous yellowish precipitate when an alkaline tungstate with excess of a soluble sulphocyanide is acidified and brought in contact with a solution of this alkaloid; it fuses at a low temperature, gradually acquiring a green colour.

The other alkaloids generally furnish gelatinous precipitates with this solution of tungsten.

A solution of the red sulphocyanide of chromium also furnishes flaky or gelatinous precipitates with the alkaloids generally; with nicotina, however, a semi-solid translucent substance forms, adherent and continuous, of a purplish colour, insoluble in alcohol or ether; heated with solution of potash it fuses, turns to a pink colour and evolves nicotina; it also gives the reaction of chromium and sulphocyanogen.

Certain of the alkaline bases also appear to form double sulphocyanide salts with certain metals and sulphocyanogen, for when mixed with a soluble sulphocyanide and shaken up with ether, the ether is but slightly coloured, but on the addition of a salt of zinc or tin the whole of the colouring matter can be removed to the ether by further agitation; the etherial solution from the tin when removed on to water and boiled, furnished oily looking blue globules which sank through the water; when long heated it becomes solid, it gave abundant indications of tin and sulphocyanogen. The presence of water or ether has not been tested for.

As before stated, these double sulphocyanides are generally characterised by their comparative insolubility in water; the degree of this, however, has only been determined in the case of the strychnia compounds with zinc, which requires about 30,000 parts of water to every part of strychnia present; it is therefore as insoluble in water as tannate of strychnia.

The behaviour of veratria with iron leads to the supposition that in those cases where solutions of metal fail to afford precipitates when mixed with the alkaloids in presence of hydrosulphocyanic acid, double sulphocyanides may still be formed.

As being connected with the subject in hand the following particulars relative to the formation of other double salts are noted here.

A double sulphocyanide of mercury and zinc falls as a crystalline precipitate when a salt of zinc is mixed with a solution of sulphocyanide of mercury; it is almost insoluble in water; no precipitate is formed with cadmium or tin in place of the zinc. Possibly a good process for the separation of zinc, cadmium, and tin from each other could be based upon their respective deportments with mercury or the alkaloids in presence of sulphocyanogen.

Double iodides of mercury or platinum with the alkaloids also form when the proper solutions for the same are mixed together; the sulphocyanides of mercury with the alkaloids are light coloured, and insoluble in excess of iodide of potassium. The double sulphocyanide of platinum and strychnia is a dark bluish red crystalline substance, feebly soluble in water, more soluble in sulphocyanide of potassium. The other sulphocyanides are generally still more insoluble in water or sulphocyanide of potassium; their colour is also bluish red.

January 17, 1868.

ON THE CHEMICAL REACTIONS IN THE ROASTING OF PYRITES.*

By J. H. TIEMANN, JUN.

Ever since pyrites has been used in the manufacture of sulphuric acid, it has been frequently noticed that instead of the roasting chamber being filled with an invisible mixture of atmospheric air and sulphurous acid, visible white fumes arise from the glowing pyrites. This has been noticed more particularly in muffle furnaces (where the pyrites is roasted in a chamber heated from the outside), and especially in Spencer's muffles, which are fifteen metres long. It is hardly possible that this occurs only in muffle furnaces; its occurrence here is more readily perceived than in other furnaces—"kilns," for instance. These white vapours, as is known, are anhydrous sulphuric acid. The condensation of liquid sulphuric acid in the flues connecting with the leaden chambers, is undoubtedly owing to this cause. The fact that these fumes are frequently, if not always formed, induced Mr. Fortman, at the laboratory of the Collegium Carolinum, in Brunswick, to institute a number of experiments on the subject.

The material used was a piece of nearly pure iron pyrites, with well-defined crystals, interspersed with quartz; analysed in the ordinary way, it yielded 50·21 per cent of sulphur. The pure pyrites FeS_2 requires 53·3 per cent sulphur. For all the experiments, the pyrites was reduced to a very fine soft powder.

The powder was placed in a hard glass tube ⅜ inch wide, which was placed in a Liebig's combustion furnace (the same as for an organic analysis), and brought to a red heat, while air was drawn through the tube by an aspirator. With careful and gradual heating, the point at which the pyrites ignites may easily be seen at the same moment with the first evolution of sulphurous acid; the white fumes make their appearance, and continue without interruption during the whole time of roasting. In the first experiment, the tube was connected with a flask containing a solution of caustic soda, and a tube with dry caustic soda between it and the aspirator. It was at once apparent that the white fumes passed through both absorbents into the aspirator; the absorption was, therefore, very incomplete, although all the sulphurous acid was absorbed. It is known that anhydrous sulphuric acid mixed with air or other gas, is very difficult to condense. It is, therefore, not surprising that in this case the white fumes were imperfectly retained; the quantity of the uncondensed portion (principally anhydrous acid) was remarkably large, as shown by analysis. 1·5 grammes of powdered pyrites were roasted; the dry caustic soda was dissolved in the solution of soda in the flask; this was oxidised with chlorine, and precipitated with chloride of barium, which gave 3·657 grammes sulphate baryta—corresponding to 33·49 per cent sulphur. According to which, 16·72 per cent of the sulphur in the pyrites was lost—as anhydrous sulphuric acid [50·21—33·49 = 16·72.] The roasted pyrites retained a small portion of sulphur at those points where it was in direct contact with the combustion tube. This evil was corrected by frequently turning the tube during the roasting, and the mass was heated gradually from the front of the tube towards the rear; in this way a residue was obtained entirely free from sulphur, and of a bright red colour.

In the above experiment, it was found that the dry caustic soda absorbed more rapidly than the solution; the soda tube was therefore changed for one three times larger, and the experiment again made, giving the following results:—Roasted pyrites, 1·366 grammes. The gases, as before, first passed through soda in solution, and then through the tube with dry soda. At the end of the operation, the soda in both was neutralised; the solution divided into two portions; one portion was immediately precipitated with chloride of barium; the other half was first oxidised with chlorine and then precipitated. The first gave 2·485 grammes, the latter 1·986 grammes, of sulphate of baryta, so that in 100 parts pyrites—

Sulphur, absorbed as sulphurous and anhydrous sulphuric acid	48·39 pts.
Sulphur, absorbed as anhydrous sulphuric acid alone	38·31 ,,
Sulphur, absorbed as sulphurous acid	10·08 ,,

So that from 50·21 per cent sulphur in the pyrites, 1·82 parts were lost by incomplete absorption (50·21—48·39 = 1·82.) According to which, the amount of sulphur eliminated as anhydrous sulphuric acid, was almost four times as great as that which passed off as sulphurous acid. An apparently unlikely result, especially when we consider that the insolubility of the sulphate of baryta in a concentrated solution, or an imperfect roasting of the precipitate, may have easily caused an error.

A more perfect result was expected by determining the sulphurous acid with iodine solution by the burette. In so far as the roasted pyrites retains more of the sulphur, and the sulphurous acid is entirely absorbed, this method must give a perfect way of determining the relation between the two acids. The anhydrous acid can easily be determined by the difference between the sulphur in the pyrites and in the sulphurous acid formed.

1·549 grammes pyrites was roasted, as before; all the caustic soda was united in one solution, and the solution was diluted to exactly 1,000 cubic centimeters. 10 c.c. treated by the well-known method, required 1·75 c.c. iodine solution (1 c.c. iodine solution = 0·00032 sulphurous acid); so that again, according to this experiment, the amount of anhydrous sulphuric acid is much greater than the amount of sulphurous acid.

These preliminary experiments, which will be continued, show that the amount of anhydrous sulphuric acid, formed in roasting pyrites, is very important, and much greater than has been supposed. They show further, that the amount varies, depending upon the temperature and other circumstances which are still to be investigated.

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* Dingler's Polytechnic Journal, vol. 187, part 2.

ON THE

DETECTION OF METHYLATED SPIRITS BY CHEMICAL REACTIONS.[*]

By Dr. J. W. GUNNING, Professor of Chemistry at the Athenæum Illustre at Amsterdam, and Scientific Adviseur to the Netherlands Ministry of Finance.

In consequence of the passing of an Act by the Netherland's States General in July, 1865, changing and greatly enhancing the excise duty on spirits, it became necessary to provide the industry of Holland with an alcohol denaturised in such manner as to be unfit for drinking purposes, and for the manufacture of liqueurs, such as Curacao, &c. The excellent success obtained with methylated spirits in Great Britain induced the Netherlands administration to allow in a similar manner the use of methylated spirits in the Netherlands. The wood spirit, or methyl alcohol of commerce is a mixture of various substances which may be met with therein in larger or smaller quantity according to differences in the manufacture, and divers methods of purification. English made wood spirit may, and often does, contain ammonia in consequence of the method which obtains here of saturating the rough pyroligneous liquor with chalk previous to distillation. The methyl-alcohol which is supposed to be chiefly present in wood spirit is very often only met with in really subordinate quantity, beside this, wood spirit contains aceton, acetate of methyl, and probably also formiate of methyl. The presence of compound ethers in wood spirit is easily proved by treating it with caustic potassa, or, better yet, by heating it in a sealed glass-tube with ammonia, and subsequent distillation, when there will be left behind in the retort salts of the acids of the previously existing compound ethers. Aceton can be proved to exist, since if wood spirit is treated with fuming nitrous-nitric acid and a salt of silver, fulminate of silver is formed. The peculiar odour which wood spirit emits, and which is rather pungent, is not owing to the substances just alluded to, but to peculiar volatile empyreumatic oily substances present in very small quantity, and not separately known in consequence of the difficulty of separating them. It is clear from what has been just stated in reference to wood spirit, that it would be utterly futile and impossible to find for such a compound as a whole a ready and perfect chemical test. One must not lose sight of the fact, moreover, that the compounds met with in wood spirit are neither of them such as are prominent by some or other conclusive and strictly characteristic test, or yield products of decomposition which are highly characteristic; while in methylated spirits, moreover, wood-spirit is mixed with ethyl-alcohol, which latter both in chemical and in physical properties bears a great likeness to the former. We are therefore obliged to have recourse to empirical reagents for detecting wood spirit in alcoholic liquids. Although it is true that methyl-alcohol yields on oxidation formic acid and ethyl-alcohol on the contrary acetic acid, and both these acids admit of being readily distinguished from each other, the plan to apply this property as a test and reagent is a too cumbrous mode of working to be adopted with ease and economy of time.

The application of the reagents known as Fuch's, to wit, a solution of iodide of potassium, and iodide of mercury in caustic potassa, and that of Reynolds', viz., chloride of mercury in caustic potassa, for the detection of wood spirit, owe their efficacy to the property possessed by the compounds met with in wood spirit to dissolve and keep in solution certain compounds of mercury which are insoluble in pure alcohol and in water. I have laboured in vain to obtain the precise composition of the precipitate which Fuch's reagent yields with pure alcohol, since I have not been able to obtain that precipitate in a sufficiently pure state. As regards the composition of Reynolds' precipitate, it is undoubtedly the yellow oxide of mercury; the following simple experiment proves this: add to a very weak solution of chloride of mercury (corrosive sublimate), a few drops of a solution of caustic potassa, and add afterwards wood spirit, when, on being shaken, it will be seen that the precipitate formed at first is entirely dissolved. While studying these reagents I have in the first place tried to determine whether this solvent action is due to all or only to some of the compounds met with in the wood spirit of commerce; it was of course also necessary to determine what influence is exerted by such substances as essential oils, fusel oil, and compound ethers, which in larger or smaller quantity may and often do occur in such alcoholic fluids wherein it is desired to detect the presence of wood spirit, and to determine whether or not they also exercised a solvent action. As regards the first point I have clearly made out that the reaction just alluded to is not caused by the pure methyl-alcohol, but is owing to other substances met with in commercial wood spirit, and especially to aceton. I have purposely prepared pure methyl-alcohol, both by decomposing pure crystallised oxalate of methyl, and by the well-known chloride of calcium plan, and on experimenting with this pure substance I have found it to behave towards the reagents above alluded to as pure ethyl-alcohol; but the precipitate which obtains is immediately dissolved on addition even of the slightest quantity of aceton. As regards the other point, I have found that many essential oils, fusel oil, and compound ethers exert a disturbing influence on the reaction of the above-mentioned tests, so that as many of these substances cannot be, either at all, or even only partly eliminated from fluids in which it is desirable to test for the presence or absence of wood spirit, the use of the test and reagents becomes either doubtful, or in many cases even impossible. I have therefore found it preferable to modify the composition and application of the reagents in some points, keeping, however, the main principle the same. Fuch's reagent is, as will be easily perceived, Nessler's ammonia test, but in this instance its use is not exactly to detect ammonia; if it so happens, however, that a fluid wherein one desires to test for wood spirit with Fuch's reagent does at the same time contain ammonia, phenomena will be observed indicating the presence thereof but it will be readily perceived also that then the reactions are more clearly defined and more strongly marked just for the very category of substances wherewith in this case one may have to deal; as a consequence hereof in the majority of instances there need not be the least uncertainty concerning the presence or absence of wood spirit. I give herewith the prescription for making and describe the use of the modified reagent as fit for the purpose for which it is here desired. Dissolve 16·66 grammes of iodide of potassium and 23·08 iodide of mercury in the smallest possible quantity of pure distilled water, this solution is then diluted with 500 cubic centimetres of alcohol, containing at least 92 per cent of pure alcohol. Also prepare a solution of ammonia, and one of caustic potassa in alcohol of the same strength; it is hardly necessary to say that the solution of caustic potassa in alcohol should be made extempore, *i.e.*, just when wanted. The alcohol to be applied for this purpose ought to be of the very purest quality; the purity may be recognised by applying the reagent just described as a test in the following manner: after the solution of the iodide of potassium and iodide of mercury has been diluted with alcohol, a few drops of the alcoholic ammonia solution should be added to a small portion of the alcoholic solution of iodides, and after that a few drops of the alcoholic solution of caustic potassa should be added; there should then ensue a beautifully brown coloured precipitate, similar in pigment to the well-known kermes mineral, without even the slightest yellow tinge. It is very seldom the case that alcohols met with in commerce are so pure, in fact I have found that and the presence of compound ethers and of fusel oil to some extent so alters the reaction of the test just described, that the precipitate obtained is always more or less divergent from the true colour it should exhibit; in order to obtain alcohol fit to be used as above directed, the alcohol of commerce should be treated with animal charcoal, and repeatedly distilled after addition of some caustic potassa. My reason for applying alcohol as solvent [menstruum rather] is that, by its use, one is not disturbed in testing scents, *e.g.*, Eau de Cologne for wood spirit, by the essential oils and resinous substances met with therein, which, if water was applied as solvent for the reagents, would become precipitated. If the reagent just before alluded to be applied to methylated spirit, no precipitate is formed at all, and the fluid remains perfectly clear. It is also the aceton present in wood spirit which prevents the formation of a precipitate with the modified test; but it is clear that the solvent power of this substance has its limits, and that thus by adding excess of the reagent to the fluid to be tested, one might be brought to erroneous conclusions. It is best to take about 10 cubic centimetres of the fluid to be examined, to add thereto, first, one or two drops of the mercurial solution, next, as much of the ammoniacal solution; and finally, from six to ten drops of the solution of caustic potassa; if no precipitate ensues, then a fresh portion of 10 c.c. should be taken, and the experiment repeated with a somewhat larger quantity of the mercurial solution. If so it happens that the quantity of wood spirit be very small, *i.e.*, if, for instance, it is less than 1 per cent, the fluid under examination will then, after the addition of the caustic potassa, not remain clear, but exhibit either an opalescence, and with some kinds of wood-spirit, even become somewhat yellow, and at the same time turbid. I have good reasons to ascribe this phenomenon to a difference in the quantity of the aceton, or of the acetate of methyl usually met with in commercial wood spirit, since, as I will explain more fully presently, compound ethers have the tendency to render the precipitate yellow. I have found it quite possible and easy to estimate even quantitatively within pretty fair range the quantity of wood spirit present in a given sample of an alcoholic fluid. It is therefore, however, best to modify the order of adding the required reagents in this manner that one first adds the alcoholic ammonia solution, next the alcoholic potassa solution, and then drop by drop, and cautiously, and at intervals of time, the alcoholic mercurial solution, until a permanent turbidity sets in; experiments made by me with mixtures of pure alcohol and 1, 2, 4, 5, and 10 volumes per cent of wood spirit, have proved to me that the number of drops of the mercurial solution applied is pretty fairly proportional to the quantity of wood spirit present in the mixture under examination.

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[*] Translated from the Dutch by A. Adriani, M.D., Ph.D., &c.

(To be continued.)

The Royal Society.—There are 53 applications for the Fellowship this year, eight of them being chemists of some standing.

Colourless Varnish with Copal.—To prepare this varnish the copal must be picked; each piece is broken, and a drop of rosemary oil poured on it. Those pieces which, on contact with the oil, become soft, are the ones used. The pieces being selected, they are ground and passed through a sieve, being reduced to a fine powder. It is then placed in a glass, and a corresponding volume of rosemary oil poured over it; the mixture is then stirred for a few minutes until it is transformed into a thick liquor. It is then left to rest for two hours, when a few drops of rectified alcohol is added and intimately mixed. Repeat the operation until the varnish is of a sufficient consistency; leave to rest for a few days, and decant the clear. This varnish can be applied to wood and metals.—*Journ. Applied Chem.*

TABLE

FOR ASCERTAINING THE WEIGHT OF A CUBIC FOOT OF ANY MINERAL ORE, METAL, EARTH, OR ANY OTHER SUBSTANCE, EITHER NATIVE OR ARTIFICIAL, FROM ITS SPECIFIC GRAVITY.*

By DR. LEWIS FEUCHTWANGER.

1728 inches comprise one cubic foot, and one cubic foot of water weighs at a temperature of 60° Fahrenheit, 62½ pounds avoirdupois. By ascertaining the specific gravity, and multiplying with 62½ pounds, the exact weight of one cubic foot is obtained.

	Sp. gr.	Pounds Avoirdupois. Cubic foot weighs.
Anthracite coal	1·5	94
Antimonial copper, tetrahedrite, or grey copper	5·0	300
Antimonial silver	9·5	600
Antimony ore, grey sulphuret	4·5	279
Antimony metal	6·5	400
Apatite, or phosphate of lime	3·0	186
Arsenical iron pyrites, mispickel	6·0	370
Asbestos	3·0	186
Asphaltum, mineral pitch	1·0	62
Baryta sulphate	4·5	310
Baryta carbonate, Witherhite	4·0	248
Bismuth	9·7	600
Bituminous coal	1·5	90
Black lead, graphite	2·0	125
Black jack blende, sulphuret of zinc	4·0	250
Bog iron ore	4·0	250
Brown hæmatite	4·0	250
Building stones, comprising granite, gneiss, syenite, &c.	3·0	186
Calamine	3·3	190
Chromic iron	4·5	260
Copper pyrites	4·0	260
Derbyshire spar, fluor spar	3·0	186
Feldspar	3·0	190
Flint	2·5	110
Loose sand	—	95
Franklinite	5·0	310
Galena	7·5	465
Gold (20 carats)	15·7 }	1000
,, (pure)	19·2 }	to 1200
Gypsum	2·3	130
Iron—cast iron	—	450
,, magnetic ore	5·0	310
,, spathic ore	3·0	200
,, pyrites	5·0	310
,, pyrrhotine, or magnetic pyrites	4·5	280
,, specular iron ore	4·5	290
,, wrought	—	487
Limestone, hydraulic	2·7	150
,, magnesian	2·5	150
Manganese, binoxide of	4·8	294
Malachite	4·0	248
Mica	2·8	160
Novaculite, or whetstone	3·0	186
Ochre	3·5	217
Platinum, metal and ores	16 to 19	1116
Porcelain clay	2·0	140
Pyrites, iron	4·5	280
Quartz, pure, compact	2·6	155
,, loose, angular, and round sand	—	100
Trap	3·0	186
Vitreous copper, copper glance	5·5	341
Wood tin, stream tin	7·0	434
Zinc, sulphide or blende	4·0	248
Zincite, red zinc ore	5·5	331
Zinc carbonate	4·4	268
Zinc silicate	3·4	200

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* Condensed from the American Journal of Mining.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, March 31st, 1868.

Edward Schunck, Ph.D., F.R.S, &c., President, in the Chair.

"*Description of a Dolerite at Gleaston, in Low Furness.*" by E. W. Binney, F.R.S., F.G.S.

During the last thirty years the tract of land known as the Hundred of Low Furness has been investigated and described by several geologists. It was one of the earliest fields investigated by the venerable Sedgwick, who has left us a most valuable memoir of his labours in that district. Since then, Mr. Jopling, myself, and Sir R. I. Murchison, and Professor Harkness, have published descriptions of the silurian mountain limestone and permian formations of the country. Miss E. Hodgson has also given us information as to the drift deposits overlying the palæozoic strata. Still, notwithstanding what has been done, it may confidently be asserted that the peninsula comprising the southern part of the Hundred of Low Furness has yet to be carefully examined before its geology can be said to be thoroughly known.

None of the above-named persons appear to have been aware of the occurrence of any trap dykes in this district, judging from their published writings, with the exception of Mr. Jopling, who, in his sketch of the geology of Low Furness and Cartmel, comprehending the Hundred of Lonsdale north of the sands, published in 1843, when speaking of the geology of Gleaston, says:—"Carboniferous limestone abounds, and in the quarries near the castle are many fossils beautifully preserved in the shale beds between those of the limestone; there is also a vein of trap." At page 72 the same author says "there are also appearances of trap near Gleaston, associated with limestone breccia."

In the month of October last, Miss E. Hodgson was so kind as to send me some specimens of rocks from Gleaston, which puzzled her a good deal. Some of the parties to whom she had sent them called them dolomites, whilst others named them traps and greenstones. To the latter opinion Miss Hodgson, I believe, was inclined to add the weight of her sanction. Not having previously seen, or even heard of, the occurrence of any such rocks in the district where they were said to be met with, I went over to examine them, and having been furnished with information by Miss Hodgson, easily found the place where they are exposed at Gleaston Green. At that time Mr. Jopling's book had not been seen by me. The space occupied by these singular rocks, at least so far as at present exposed, is so limited that all that can be seen is very soon ascertained. Specimens were collected, and a few observations made. The former, by the kindness of my friend Professor Roscoe, F.R.S., were analysed for me in the laboratory of Owens College. It is only by the labours of the chemist that geologists can with any certainty decide upon the age and origin of such rocks as those which are met with at Gleaston.

On approaching Gleaston Green from Scales, the mountain limestone appears to occupy the country so far as it can be seen. In a quarry below the old castle on the roadside, this rock in the northern part is very hard, and dips to the west at an angle of 25°, whilst in the southern part, where it is softer, it dips in the same direction at an angle of 16°. Owing to the covering of drift, the limestone is not seen nearer to the mill, but it probably extends further in that direction. At a short distance below the mill, dark-coloured laminated shales are seen in the bank on the roadside, dipping apparently at an angle to the N.N.W. We then come to the rocks at the end of the Green. They appear to run in an east and west direction, and are not now exposed for more than twenty yards. From north to south they may probably extend about forty yards, but certainly for more than half of that distance, towards the beck, they are not now seen until the land rises on the bluff south of the beck, where they reappear as a reddish and bedded trap ash, having an east and west direction, and dipping N.N.W. at an angle of about 60°. This ash is succeeded by a coarse breccia of a few yards in thickness, so far as exposed, which dips slightly north of west, at an angle of 25°, and then is covered up by grass so as not to be seen, but no doubt, from sections in the adjoining lane and borings made on the rise of the strata, dark-coloured shales occur again, and the dyke most probably intrudes through these shales, which are in every respect like limestone shales, but no organic remains were observed in them so as to make us certain of their geological age.

Returning to the north side of the beck, nothing is exposed of the district west of the hard rocks seen on the Green, owing to the thick covering of drift in that direction; but Mr. Hodgson has proved, by a series of bore-holes, the occurrence of upper permian sandstone, red shale, and limestone shale—the first to the S.W., the second to the west, and the third to the N.W. of Gleaston; and Mr. Ashburner has proved limestone shale and limestone in bores to the E. and N.E. of the locality where the rock is found.

In the bluff on the south side of the stream, as previously stated, the rock appears more like a trap ash of a reddish brown colour, and exhibits traces of bedding and white lines like carbonate of lime. Immediately adjoining trap ash, and on its rise, occurs the coarse breccia composed of fine-grained siliceous rocks, cemented together with quartz, and like a permian breccia; but although the beds are near together, there was not evidence to show whether the trap ash gradually passed into the breccia or intruded through it, still the breccia appeared to dip in the same direction, but at a much less angle, namely, 25° to a little west of north. This is a very interesting fact to prove; for if the rock graduates into the breccia, it would appear to be of permian age, and most probably a melaphyr, but if it is intrusive, as the evidence on the whole appears to prove, all we can say is that it is of later date.

This breccia is composed of angular pieces of a fine siliceous stone, of a pink colour, more resembling quartzite than anything else, cemented together by small quartz crystals, and containing minute quantities of protoxide of manganese. The form of the fragments is very like that of the rocks in the permian breccia of Rougham Point, near the mountain limestone of Humfray Head, and there consisting for the most part of the neighbouring mountain limestone, but no limestone has yet been met with in the Gleaston breccia as might have been reasonably expected; and the pink quartzite is a rock hitherto unknown in the district. The permian breccia, so far as my experience goes, although sometimes containing volcanic ash, are composed of the rocks now found in the neighbourhood where they occur, and nearly always vary with the older geological rocks of the district. The composition of the Gleaston breccia makes me hesitate in designating it as permian, as it may be some rock altered by the dyke.

The rock in its best state of preservation is remarkably hard, of a reddish brown colour, has a moderately straight fracture, and a pinkish white streak, and its specific gravity is 2·92.

Three average samples of the rock were taken, two from the north and one from the south side of the beck. All of them were more or less decomposed by exposure to air and moisture, but No. 26 much less than Nos. 23 and 24. Professor Roscoe, on analysis, found their present chemical composition to be as follows:—

	South of Stream, No. 23.	North of Stream, No. 24.	North of Stream, No, 26.
Silica	45·54	50·96	51·10
Peroxide of iron	24·76	24·20	21·58
Alumina	7·70	14·48	9·40
Lime	13·84	7·32	6·24
Magnesia	0·57	0·55	1·33
Carbonic acid	2·78	1·90	2·70
Alkalies, water (by difference)	4·82	0·59	7·65
	100·00	100·00	100·00

The only rock which I know of a similar composition is a probable variety of green earth, resembling a decomposed pyroxene, described by Macfarlane in the *Canadian Naturalist*, New Series, vol. iii., No. 1, page 5, in a paper on the cupriferous bed of Portage, Lake Michigan, which consists of—

Silica	46·48
Alumina	17·71
Protoxide of iron	21·17
Lime	9·89
Magnesia trace	—
Alkalies (by difference)	1·97
Water	2·78

Mr. David Forbes, F.R.S., to whom were forwarded small specimens of the rocks and the above analyses, kindly informed me that the rocks were so much decomposed that it was difficult to pronounce with certainty as to what they were, but he was inclined to think that they were an intrusive dolerite of carboniferous age rather than a melaphyr. The iron had been changed from a protoxide into a peroxide, and the lime had resulted from the decomposition of a lime felspar. As Mr. Forbes had found the presence of titanium united with iron in all the carboniferous dolerites he had examined, I took several ounces of the three samples above given, and having heated them in a crucible so as to convert the iron from a per into a protoxide, extracted it by a magnet. About half an ounce of this iron was very carefully examined by Mr. Thorpe in Dr. Roscoe's laboratory, especially for titanic acid, and no trace of that substance was found. He used the test with microcosmic salt, having separated iron and silica. The absence of titanium in the rock would lead us to believe that it was of later origin than the carboniferous age, but if traces of that metal had been found, it would not only have settled the question as to the age, but it would have shown a connection with the hæmatite iron ores of Whitehaven and Ulverston, all of which contain more or less of titanium as proved by the deposits of that metal found on the sides of old furnaces where hæmatite has been smelted. Is the rock of permian age? It is certainly not much unlike the melaphyr of the German geologists, and the breccia near the dolerite is not greatly different from that of Ballochmyle, described by Mr. A. Geikie, F.R.S., in the *Geological Magazine* for December, 1866, but we could not obtain direct evidence that the breccia gradually passed into the trap, the latter appeared to protrude through it, but certainly the trap and the breccia dipped in the same direction, the one at about 60° and the other at 25° a little West of North. This point can only be satisfactorily determined by cutting a trench and showing the contact of the breccia with the trap. The extent of the dyke can only be traced for a few yards east and west, as previously stated, and none of the hæmatite iron deposits, so far as known, have been found south of it. Its age also appears to be more recent, even supposing it to be permian, than those deposits which for the most part must be considered of carboniferous age. The occurrence of this trap might have been considered to have some connection with the deposition of the iron had it been of carboniferous age, but it is evidently more recent, and therefore could have had nothing to do with it further than disturb or displace it.

"*A Search for Solid Bodies in the Atmosphere*," by R. Angus Smith, Ph.D., F.R.S., &c.

I have so frequently for many years attempted to find, and have found, organic substances which have passed from the air into liquids in which they were collected, that perhaps the Society will scarcely attend to another attempt, although it indicates, I think, some progress. It was in the year 1847 that I first collected what I believe was matter from the respiration and perspiration, and found that as it was kept it grew into distinct confirmed forms.

Whilst examining some matters relating to the cattle plague I found one or two remarkable points. I had before that time used aspirators to pass the air through liquids, except in the oxidation experiments. At that time I used simply a bottle which contained a little water. The bottle was filled with the air of the place, and the water shaken in it. The difference of air was remarkable. A very few repetitions would cause the liquid to be muddy, and the particles found in many places were distinctly organic.

It may, however, interest the Society to hear of a few of these previous attempts, the latest made till recently. I shall therefore read from a report to be found in the appendix to that on the cattle plague.

"Mr. Crookes also brought me some cotton through which air from an infected place had passed. It was examined at the same time. Taking cotton in the mass nothing decided was seen; but when it was washed some of the separate films were coated over with small nearly round bodies, presenting no structure, or at least only feeble traces of it, and perhaps to be called cells. I had not sent gun-cotton, as I intended, to Mr. Crookes, fearing the rules of the post; otherwise there would have been more certainty that the bodies spoken of did not exist previously on the cotton. However, Mr. Dancer, who has examined cotton with the microscope oftener than most persons, even of those experienced in the subject, had never observed a similar appearance.

"The liquid had also a number of similar bodies floating in it.

"It was then that Mr. Crookes sent a liquid which he had condensed from the air of an infected cowshed at a space a little above the head of a diseased cow. It was also examined, and it presented similar indications of very numerous small bodies. Not being a professed microscopist I shall not attempt a description, but add that they clearly belonged to the organic world, and were not in all cases mere débris. We found also one body a good deal larger than the rest; it resembled somewhat a paramecium, although clearly not one.

"We found no motion whatever, and only this latter substance could be adduced as an absolute proof of anything organised being present. Next day I examined the same liquid; and, whether from the fact of time being given for development or from other causes, there was a very abundant motion. There were at least six specimens in the field at a time, of a body resembling the euglena, although smaller than I have seen it. When these minute bodies occur it is clear that more may exist, and germs in this early stage are too indefinite to be described. The existence of vital sparks in the organic substances in the air alluded to is all I wish to assert, confirming by a different method the observations of others. It might, of course, be said that since the bottle was opened at Mr. Dancer's, the air at that place may have communicated them. I answer that, before it was opened, a good glass could detect floating matter, some of it, however, as in the microscope proved, indefinite enough.

"Finding this, and fearing that the long time needful to collect liquid from the atmosphere might expose it also to much dust, I used a bottle of about 100 cubic inches dimensions, and putting with it a very little water, not above five cubic centimetres, I pumped out the air of the bottle, allowing the air of the place to enter. This was done six times for each sample, the water shaken each time, and the result examined. This was done with the same bottle that was used in my early experiments with permanganate, and by the same method, except that water instead of that salt was used. At first considerable numbers of moving particles were found; but it was needful to examine the water used, and here occurred a difficulty. It was not until we had carefully treated with chemicals and then distilled the water again and again that we could trust it. Particles seemed to rise with the vapour, and if so, why not with the evaporating water of impure places.

"Having kept an assistant at the work for a week, and having myself examined the air of three cow-houses, I came to the conclusion that the air of cow-houses and stables is to be recognised as containing more particles than the air of the street in which my laboratory is, and of the room in which I sit, and that it contains minute bodies, which sometimes move, if not at first, yet after a time, even if the bottle has not been opened in the interval. There is found in reality a considerable mass of débris with hairs or fine fibres, which even the eye, or at least a good pocket lens, can detect. After making about two dozen trials, we have not been able to obtain it otherwise. Even in the quiet office at the laboratory there seemed some indications.

"I found similar indications in a cow-house with healthy cows; so I do not pretend to have distinguished the poison of Cattle Plague in these forms; but it is clear that where these exist there may be room for any ferment or fomites of disease; and I do not doubt that one class is the poison itself in its earliest stage. It would be interesting to develope it farther.

"I have recorded elsewhere that I condensed the liquid from the air of a flower garden, and found in it, or imagined I found, the smell of flowers. I do not remember that I looked much to the solid or floating particles, thinking them to be blown from the ground, but it does not affect the result, whether they be found constantly in the air or are raised by the action of currents."

Lately I tried the same plan on a larger scale. A bottle of the capacity of 4990 c.c. was filled with air and shaken with water. The bottle was again filled and shaken with the same water, and this was repeated 500 times, nearly equal to 2½ million c.c., or 2,495 litres. As this could not be done in a short time, there was considerable variety of weather, but chiefly dry, with a westerly wind. The operation was conducted behind my laboratory, in the neighbourhood of places not very clear, it is true, but from which the wind was blowing to all parts of the town. I did not observe any dust blowing, but if there were dust, it was such as we may be called on to breathe. The liquid was clouded, and the unaided eye could perceive that particles, very light, were floating. When examined by a microscope the scene was varied in a very high degree—there was evidently organic life. I thought it better to carry the whole to Mr. Dancer and to leave him to do the rest, as my knowledge of microscopic forms is so trifling compared to his.

ROYAL GEOLOGICAL SOCIETY OF IRELAND.

April 8, 1868.

Dr. Emerson Reynolds read a paper "*On the Formation of Dendrites.*" He had some years since noticed that when solutions of salts, &c., were placed upon a plate of clean glass, and the glass placed between the poles of a Ruhmkorff's coil, the salts gradually work over the surface of the glass in beautiful moss-like forms, which in many cases were characteristic of the compound contained in solution. The state of dilution at the same time having some considerable influence. The authors proposed to call them "electric cohesion figures." To produce them we will say that a drop of a solution of cyanide of potassium is put in the centre of a plate of glass, which is then placed upon a sheet of tin-foil. One pole of the coil is then brought into contact with the foil (it is immaterial which), and the other pole is placed in the centre of the drop; immediately on passing the current the solution begins to creep over the surface of the glass in moss-like convolutions.

The dendritic markings on minerals the author believed were formed under a similar condition. He exhibited a beautiful manganous dendrite taken out of the museum. It was a slab of concoidal limestone, and in Dr. Reynold's opinion illustrated his electrical explanation conclusively. There was originally a flaw in the limestone which was exactly at right angles with the plain of cleavage. Through these flaws, as was evident by the marks, the manganous solution had percolated, and had perhaps ultimately been the means of making the stone part in two, not however in the direction of the flaws, but in the plain of cleavage. The dendrites which were formed upon the surface in this case were produced from the well known fact that the two surfaces at the instant of their separation are in opposite electrical conditions.

This phenomenon may be illustrated to a certain extent by inserting a drop of the fluid into the interstice of a plate of mica, and then on suddenly parting the plate the dendritic forms are shown. To fix them the author dusts some finely dried pigment over the surface of the still moist plate, and then fixes this by some transparent varnish.

The other paper read was by J. Scott Moore, Esq., J.P.D.S., "*On Man and the Glacial Epoch.*" A modified spectroscope for examining minerals was also shown.

FOREIGN SCIENCE.

Paris, April 13, 1868.

Examination of fatty matters.—Manufacture of porous carbon.—New method of preparing magnesium.—Industrial preparation of oxygen.—Academy of Sciences.—Meteorites.—New compound of platinum.—Eruption of Vesuvius.

An ingenious method of testing fatty matters, founded upon the solubility of rosaniline in certain fatty acids, has been devised by M. Jacobsen; it is applicable, among other things, to the examination of cod-liver oil. A little piece of dry rosaniline placed in a sample of perfectly neutral oil, agitated and heated upon the water bath, remains undissolved, but if placed in a rancid oil, a red tint is rapidly developed. Oleic acid and the other fatty acids dissolve rosaniline in large quantity, and become opaque from the depth of the tint, because oleate of rosaniline is soluble, in all proportions, in oils and other fatty substances. This property enables the presence of fatty acids in oils to be detected. For instance, in commerce we have had for some years pretended white cod-liver oils which are only fatty fluids from very young animals, or veritable cod-liver oil, but which has been agitated with potash, allowed to repose and filtered. Since the therapeutic effects of cod-liver oil depend essentially upon the amount of free fatty acids which it contains, neither of these white oils can be valuable. Genuine cod-liver oil agitated with a little rosaniline is promptly coloured red, in the cold, and if heated upon the sand bath, the colour is very deep, while the bad specimens already referred to remain perfectly uncoloured.

When an oil which is only slightly rancid, contains but a small amount of fatty acids, the colouration often does not become sensible at first. In this case it is better to prepare a solution of rosaniline in absolute alcohol, and add a few drops of this to the oil to be examined, and heat on the water bath until all the alcohol has been evaporated. If no fatty acid exist, the rosaniline soon separates and rises to the surface, or when the oil is too thick, rests in suspension as a brown powder. Samples of ordinary oil occurring in commerce, have given the following results:—Olive oil and that of sweet almonds remained uncoloured by rosaniline; poppy oil became slightly red; linseed oil became strongly coloured, its natural colour rendering the tint brownish; palm oil gave a colouration still more intense. One more experiment, it has sufficed to mix the olive oil with 5 per cent of oleic acid, to obtain with rosaniline a tint equal to that of raspberry juice. It is not proposed to heat to more than 100° C., otherwise errors might occur.

The fabrication of porous carbon, in various shapes, engages the attention of no inconsiderable number of persons in the present day; this kind of carbon is made most advantageously, your correspondent is informed, by the following process:—A mixture of wood charcoal and animal charcoal is ground to a coarse powder, mixed with sawdust, and dried at a steam heat; as soon as the material is dried, and while still warm, 20 per cent of tar is added. When cold a certain amount of asphaltum is added, and the mass pressed into moulds. The proportions in which the ingredients are used vary according to circumstances. The moulded objects are placed in boxes of sheet iron, and covered all over with a mixture of sand and charcoal; afterwards they are heated on the sole of a furnace. Gases which are disengaged during the operation are burnt in the furnace. The entire operation lasts about twenty-four hours. Careful attention is required during the calcination; the properties of the carbon depend, in a great measure, upon the management of this part of the process.

M. Reichert has devised a new method of preparing magnesium. He takes 1,000 grammes of the anhydrous double chloride of magnesium and potassium, pulverises it, and mixes it with 100 grammes of finely powdered fluor spar; this mixture is fused with 100 grammes of sodium. The compound proposed for use occurs in the mineral kingdom in tolerable abundance as carnallite. White pieces of this mineral are available, and require no previous treatment; coloured fragments must be dissolved in water, the impurities allowed to settle, and the lixivium evaporated.

M. Gondolo has made some improvements in M. Boussingault's process of extracting oxygen from the air by means of baryta. M. Boussingault, in 1852, found that in passing a current of air over baryta, heated to dull redness, oxygen was subtracted from the air, and binoxide of barium formed, and that upon then raising the heat to bright redness the oxygen was set at liberty so easily that the oxygen might be first absorbed and then evolved *ad infinitum*. M. Gondolo has made, in carrying out the detail of the process, certain changes which admit of oxygen being prepared upon a manufacturing scale. For the porcelain tubes he substitutes iron ones, which may be made either of wrought or cast iron. Internally a coating of magnesia is applied, and externally asbestos, so as to diminish the porosity of the tube and the consumption of fuel. These tubes are arranged in a brick furnace having dampers, by means of which the temperature may be changed at will, and dull redness and bright redness easily obtained. To the baryta a mixture of lime, magnesia, and a small quantity of manganate of potash is added; this prevents fritting of the material. M. Gondolo says that he has made 122 alternate operations, and that the atmospheric oxygen and nitrogen are easily separated upon an industrial scale; the apparatus has been at work during six months, and fulfilled its purpose thoroughly. The process is patented.

There were few memoirs relating to chemistry at the séance of the 30th March. M. Daubrée gave some further account of various meteorites. M. Balard presented a note by M. Schützenberger on a new compound of platinum. M. Frémy presented a note by M. Terreil, "on the action of saline solutions on minerals." Besides these there was a geological paper entitled, "On the actual eruption of Vesuvius," from M. Silvestri. The first mereorite M. Daubrée referred to was one found in the Philippine Isles, not far from the village of Mexico, province of Pampanga, said to have fallen in 1859. It appears to be of the common type; it consists of a confused, stony, crystalline mass, chiefly composed of magnesian silicates, in which are disseminated bright particles, having a metallic lustre; some are grey, and are particles of nickeliferous iron, the others, black, are composed of chrome iron; the latter are very numerous. The meteorite is traversed by black veins, which give it a marble-like appearance; it presents great resemblance, both in the pale portions and in the dark veins, to the meteoric stone which fell on the 5th August, 1812, at Chantonnay. The density of the meteorite from the Philippines is 3·61, that of the meteorite from Chantonnay 3·67. Treated by boiling hydrochloric, the meteorite now studied by M. Daubrée leaves 28·5 per cent of a residue not at present examined; the solution contains magnesia, protoxide of iron, a little oxide of nickel, and a very small quantity of alumina. Another meteorite, which fell at Murcie, in Spain, on the 24th December, 1858, formed the subject of a memoir by MM. Daubrée and S. Meunier. This meteorite is a very remarkable one, and was exhibited at the Universal Exhibition of 1867. Its density is 3·546, and it weighs about 114 kilogrammes. The mass is nearly entire, that is to say, the crust is almost everywhere apparent. This crust does not present the aspect ordinarily presented by stony meteorites; it has evidently suffered profound alteration since its formation. Particles having a metallic lustre are rare, but there are some—they consist of nickeliferous iron. In other places bronze yellow particles are seen, which have the characters of troilite. There exist, also, in this meteorite very brilliant particles possessed of a kind of metallic lustre. These particles also form veins. A careful examination has shown them to be crystals of hyaline By the blowpipe flame they are melted to a greyish enamel, and give the reactions of silica and alumina. The black portion of the meteorite which was considered least altered, was analysed by M. Meunier. The magnet separated 14·99 per cent of magnetic matter formed of nickeliferous iron and a trace of phosphide. Foremost among the analytical results, sulphide of iron is observed as making 20·52 per cent; this is doubtless the cause of the dark colour. A silicate attackable by hydrochloric acid, of the nature of peridote, gives 38·69 per cent, and a silicate resisting this acid, of the nature of pyroxene, 24·64 per cent.

M. Schützenberger, in endeavouring to effect the synthesis of oxychloride of carbon without the intervention of light, made a mixture of dry carbonic oxide and chlorine pass over platinum sponge heated to 400°. Under these conditions, the formation of sensible quantities of oxychloride of carbon takes place, but the platinum does more than exert catalytic action. A solid and volatile compound of platinum is produced which passes away with the current of gas, and may be collected in the form of a clear yellow flaky powder in the cold part of the tube. As the platinic compound is destroyed at a temperature little above that at which it is formed, to succeed, the current should be rapid. The new substance melts at about 150°, yielding a transparent yellow liquid, which on cooling solidifies to a crystalline yellow mass: in other experiments, an analogous product has been obtained, melting at 125°, whence the substance would not seem to be homogeneous. At a temperature of 350 to 400° it boils and distils, but decomposes in great part into metallic platinum and chloroxycarbonic acid. The substance is decomposed by water immediately in the cold, an effervescence of carbonic acid being produced, at the same time that a fine black powder is separated, and the filtered liquid, quite colourless and free from platinum, gives the reactions of a solution of hydrochloric acid. The black powder is pure platinum (representing the whole amount of platinum in the body) possessed of great catalytic power, and below redness, it is converted, sometimes with incandescence, into very coherent metallic platinum. The mode of formation, and the decomposition of this body, under the influence of heat, and with water, leave no doubt as to its constitution. It is a compound of platinum, chlorine, and carbonic oxide. The most simple formula would be $(\text{ꞒO})''$, $\text{Pt}''''\text{Cl}_2$, in which Pt = 66·55, Cl = 23·9, and C = 4·05. Analysis has not confirmed this formula. A specimen crystallised from tetrachloride of carbon, and very pure in appearance, was analysed, it gave Pt, 63·5; Cl, 22·9; C, 5·35. These numbers lead to the formula $(\text{ꞒO})_3\ \text{Pt}_2\text{Cl}_4$, in which Pt = 63·5, Cl = 22·9, C = 5·8. The product first obtained was, as has already been mentioned, purified by chloride of carbon; the crystals obtained after several purifications contained less platinum, and gave 60·87 per cent upon analysis, afterwards a minimum of 58 per cent of platinum. M. Schützenberger proposes to examine this point further.

M. Terreil's note will be referred to again.

M. Silvestri has examined the phenomena connected with the eruption of Vesuvius closely, and analysed many of the volcanic products. The lava is dark grey coloured, sometimes greenish or reddish on the surface. The substance possesses a crystalline structure; it exerts an energetic action on the magnetic needle. M. Silvestri distinguishes four kinds of lava; the density of these varied between 2·46 and 2·81; in a complete analysis recorded of one, compact lava, water was found to be present to the extent of 2 per cent. Three distinct kinds of sublimates were noticed, viz., white, greyish brown, and green. The white sublimate contained chloride of sodium and chloride of potassium, besides minute traces of chloride of copper. Oxide of copper is present in the greenish brown sublimate, of which it forms 5·85 per cent. The green sublimate contained ·61 per cent of oxychloride of copper; all these sublimates are mainly composed of chlorides of sodium and potassium. A large quantity of the sublimates was dissolved in water and a series of crystallisations made, in the mother-liquor reduced to a small volume, iodine and bromine were sought for; neither were detected. A spectral examination of the mother-liquor revealed nothing but sodium, potassium, and copper. M. Silvestri made his observations at the end of December, about the time of the maximum activity.

CORRESPONDENCE.

PERMANGANATE OF POTASH AND ORGANIC MATTER IN WATER.

To the Editor of the Chemical News.

SIR,—I have just read a letter in your number of the week before last, in which, after all that has been said to the contrary, the above-named substance is still spoken of in terms of approval as affording a means of estimating organic matter in water. As my opinion on the point differs in all respects from that expressed by the writer, and finding, more especially, that he has left untouched a main element in the question (if it be one), I shall be obliged if you will permit me to say a few words thereupon in this week's number of the CHEMICAL NEWS.

Soon after this method was proposed by the Danish professor, I made a series of experiments with it on a variety of naturally impure waters, but on finding the results so utterly irreconcilable with those arrived at by careful incineration of other portions of the same samples, I gave it up; though I must add that I did not then arrive at the source of its leading fallacy.

After these experiments, happening to meet the late Professor Clark, of Aberdeen, who took considerable interest in most matters connected with water analysis, and mentioning my results to him, I soon found that he also had arrived at a similar opinion as to the fallacious character of this mode of estimation.

Though I have frequently had occasion to express my unwillingness to be bound in any way by results obtained by the method, yet continuing to hear of its being much in use, I began to think that, with all my care, I had possibly mistaken some important points; and hence I was led to make another series of experiments a few years after.

Meanwhile, I am bound to say that I never found permanganate in much favour amongst the hard working "laboratory men," but chiefly amongst officers of health, public lecturers, and others, too glad to find this ready though empirical mode of operation to be easily induced to give it up, or at any time question its accuracy too closely.

On several occasions where I have found results put forward in evidence as to organic matter, greatly disagreeing with those of others, it usually came out, on cross-examination, that they were obtained by permanganate; but on finding its accuracy doubted, I have heard some of the firmer men add—that they had estimated by incineration as well, and that the two processes substantially agreed—a result, I may add, which I have never been able to realise. However, discrepant statements of this class have greatly tended to shake the faith of legal functionaries, as well as the public, in chemist's conclusions.

Some years ago, and since the introduction of the permanganate mode, a chemist of some public standing, but who had a good deal of public lecturing to attend to, gave evidence to a government committee, on which I was engaged, as to the quality of a certain water. He stated that it contained seven grains of organic matter in a gallon, whilst I, on the other hand, had been unable to find more than one grain. Both of our samples were taken at the same place, and on the same day, all of which I had to state subsequently in my evidence to the same committee. This led to the water being analysed by other chemists, none of whom I may mention found the seven grains of organic matter at first stated. Though I strongly believed that the doubtful results in this instance had been arrived at by the use of permanganate, yet from the absence of counsel on government committees I was unable to have the question put. This, and some other circumstances of a like nature, induced me to enter on the second series of experiments on permanganate to which I have already referred.

On this, the second occasion, the samples of water were synthetised for the experiments, that is to say, given portions of the usual earthy salts were dissolved in doubly distilled water, to which were added measured portions of various impure as well as pure organic decoctions, so as to accurately represent varieties of impure water. In some of the experiments, the organic matter was represented by soakings of putrescent manure, but in all considerable care was taken that the precise quality of the water used in each should be accurately known, irrespectively of either of the modes of analytical examination employed.

At this moment I have neither time nor inclination to hunt up, or put into shape, my notes of those experiments, but which will, I am sure, be deemed of less consequence when I have cited one example of the fallacious action of this very beautiful salt of potash, and which it will be seen must necessarily apply to most if not all waters.

I need hardly say, in this journal, that all potable water in this and in most countries, contains some iron, and not unfrequently traces of manganese—though the latter, being so small, is often estimated as iron. At the same time, with the exception of so-called chalybeate waters, either of these metals are usually found so very sparingly as to render their presence inappreciable to all but the analyst. Notwithstanding which, a third or a quarter of a grain of iron in a gallon is far from an unusual quantity; whilst in chalk waters, which are the freest from iron, may be found a tenth of a grain, though this quantity is often set down as "a trace." It is also to be remembered that iron in water is usually estimated as "oxide," but in which state I need not say it never exists in the water, but usually as a colourless superprotocarbonate; that is to say, the iron found in the residuum of our evaporation in the state of oxide, after incineration, existed in the water as white proto-carbonate, and which is held in solution as chalk is, by an extra atom of carbonic acid. Grains of the white proto-carbonate pervade sand and soils to a much greater extent than is supposed, and, while in this state, is readily taken up by the water.

Permit me now to recapitulate the action of the permanganate, which I need hardly repeat here is briefly this:—It acts in water by readily imparting a portion of its oxygen to bodies requiring the same. As soon, however, as this oxygen is given out, the permanganate loses its splendid colour, and hence, obviously, arose its employment as a test. Now, as organic matter when dissolved in water has an affinity, or, let us say, an appetite for oxygen, so that when permanganate is added to a water in which this impurity exists, this manganic salt loses its colour, and the quantity of it thus decolourised is said to stamp the quantity of the organic matter present in the water. In a word, the presence of the one is said to be in a direct ratio with the loss sustained by the other.

Now, this might be all very well if it were true that impure organic matter was the only class of substance incident to water, and to which the permanganate is disposed to give out its oxygen, and thus deprive itself of its beauty. Such, however, is very far from being so, for, as we shall see, the salt in question is far more disposed to give out its oxygen to a really salubrious body which is as much incident to water as organic matter. Indeed, much more so if we take organic matter of the worst class.

As I have already stated—and it is only repeating what all admit—every potable water may be said to contain some iron, and this usually as a proto-salt. Now, as a tenth of a grain of a proto-salt of iron or manganese dissolved in water, will rapidly decolourise as much permanganate as three or four grains of even putrescible organic matter, I leave it to your correspondent and those who so tenaciously hold to this mode of estimation, to say whether the decolourisation of permanganate which takes place in a given sample of water, is due to noxious organic matter or to really salubrious iron, either of which it may obviously contain? But surely all this must be already familiar to the readers of your journal.

However, should the author of the letter in question (Mr. Muter) entertain any doubt on the matter, he may easily improvise an experiment.

Let him take a grain of proto-sulphate of iron—being the easiest come-atable proto-salt—and dissolve it in a gallon of any water, hard or soft, though distilled will be the most reliable, and then let him add his permanganate. I venture to say that if he were operating on water with the quality of which he was unacquainted, he would set this distilled water down as unfit for human use, as being greatly contaminated with putrescible organic matter. I may remark that a grain of protosulphate of iron with its seven atoms of water, and its acid, will very nearly represent the tenth of a grain of oxide, so often found in most waters. In some of my experiments I used, for the sake of accuracy, mineral proto-carbonate dissolved in carbonic acid under pressure, but I find any proto-salt is affected similarly by the permanganate. But above all, I find that this very salt is used by the volumetric men, as a mode of estimating iron; but how, in the face of this, it ever could have been used for separating another body in which the first was so likely to be present, and for which it has an equal affinity, is I confess a puzzle to me, unless indeed there is some mode of masking the one, whilst the other performs the required duty.

Let me add, in conclusion, that this objection to the use of permanganate is far from being the only one though it forms a most striking one.—I am, &c.,

Thos. Spencer.

32, Euston Square, London, April 15th, 1868.

P.S.—I omitted to state that the water said to contain seven grains of organic matter came from highly ferruginous gravel, and contained a considerable amount of iron. It is probable, therefore, that if tested by permanganate, this iron would figure in the analysis as the organic matter in question.

ROYAL SCHOOL OF MINES.

To the Editor of the Chemical News.

Sir,—We hear much about the School of Mines in Jermyn Street. Can any one give me a comparative sketch of the advantages and cost of entrance of the Ecole des Mines in Paris? I have never seen it, but I hear rumour of supplies of oxygen, of economy for students, and of the greatest courtesy to strangers, of which I would fain learn more.

A great want in London for students and experimentalists who have advanced beyond a certain point, is an upper class-room, so to speak, where they can work at peace, uninterrupted by very young students, and be supplied with reliable reagents, so avoiding the worry and loss of time involved in having to test everything used, and possibly make it for themselves after all, and a comfortable room for weighing both on the balance and in their mind.

I hear reports of a new laboratory in King's College, and of one at the Royal College of Chemistry. The class of men interested in investigations, but not prepared to set up their own laboratories, must be large, judging from the number I have met. Surely if their requirements were met, a large class would be formed who would make such a laboratory by no means a losing concern, especially with attendants who would do some of the "dog-work," and an assistant whose time was entirely devoted to the interests of the class,—I am, &c., An Aspirant.

To the Editor of the Chemical News.

Sir,—I feel considerable interest in the subject of the School of Mines, having served an apprenticeship after the fashion common amongst the coal miners of the north of England, and having all my life studied how my mining education might have been more thoroughly carried out.

I have met with several French mining engineers, and thus had the means of comparing my own science and practice with theirs, and also in the same way I have come across gentlemen educated at the Royal School of Mines in London.

You and the majority of your readers know what it is to be able to form an opinion which is satisfactory to yourself, and upon which you have no hesitation in acting; it is a condition only arrived at by personal experience obtained in the observation of facts, assisted by the mind educated to appreciate the value of all things seen which have any bearing upon the matter in question.

Now as far as I have been able to judge from what I have seen of the college-made mining engineers, they have been supplied with the "educated mind," but have been allowed to get too old readily to absorb the practical experience; a man of twenty-one does not like to begin the rudiments of practical life, and most assuredly he cannot obtain them during the vacations; there must be a considerable amount of every-day life for a man to get practical experience.

What I have to suggest is that the system prevalent amongst doctors and lawyers should be adopted. Let each mining student serve a regular apprenticeship to a mining engineer in practice, and combine it with the theoretical college studies.

In order to do this effectually, colleges should be instituted in the centre of mining districts. For a Doctor of Physic or Divinity it does not particularly matter where he is educated. The former has the London Hospitals and abundance of subject matter under his very nose, where he can work up his practice in special paths not open to him in his country life, but for the London mining student, what has he to study in practice? unless he perhaps indulges in a field day amongst the sewers or underground railways.

Do not for a moment suppose that I wish to depreciate the value of college studies; but I think a man can more readily pick up theory while in practice, than he can after becoming a man bring himself down to the details required to get practice; and I therefore say, bring your schools to the mines and don't continue to try to take the mines to the schools. Have a college for science in London, as suggested by "Delta" and "A. L. E.," if you like, but don't call and use as a College of Science a School of Mines.—I am, &c.,

A. L. S.

RULE OF THUMB.

To the Editor of the Chemical News.

Sir,—The following astounding mixture for tempering steel chisels is given by a man, signing himself *Practical Experience*, in the pages of one of your contemporaries. When such absurdities as this pass current every week for scientific information, can there be a doubt of the necessity of elementary chemical instruction amongst the working classes? If it did no other good, it would at all events disclose to them the depth of their own ignorance, and teach those with *practical experience* not to be so ready to sneer at *science*:—

"The following is the mixture I have used:—Soda 2 oz., saltpetre 1½ oz., prussic acid 1 oz., (or oil of vitriol 2 oz.), soft water 3 gallons."

I am, &c., F.R.S.

MISCELLANEOUS.

Royal Dublin Society and the Royal Visit to Ireland.—The Royal Society are to give a *Conversazione* to the Prince and Princess of Wales on their arrival in Dublin. The Society's House in Kildare Street is being prepared for the occasion. The objects exhibited will be of scientific and art interest, particularly the latter. Part of the *suite* of rooms used for the occasion will be the Natural History Museum, which so far has not been open to the public since the present fine building has been erected. The minerals, &c., have been entirely re-arranged.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Journal für Praktische Chemie.
December, 1867.

C. O. Grass, "Researches on the Analysis of Inflammable Gases, with especial Reference to that of Illuminating Gas." C. Winkler, "Contributions to the Knowledge of Indium." C. Barford, "On Gallate of Silver.

Annales du Génie Civil.
December, 1867.

Lardani, "An Improvement in the Manufacture of Sulphuric Acid." Luhmann, "An Improvement in Blast Furnaces." Coste and Taupin de Rosnay, "A Method of Obtaining Ammonia from Sewage and from the Waste Waters of Manufactories." Perier and Possoz "On the Use of Lime for Preserving Beet Juice."

Bulletin de la Société d'Encouragement.
October, 1867.

Guerard-Deslauriers, "On the Use of Bisulphide of Carbon for Estimating the Quantity of Tar, Pitch, and Resin contained in Artificial Fuel." S. de Luca, "On some Important Products obtained rom the Olive and from the Australian Myrtle."

Comptes Rendus.
December 16, 1867.

A. Wurtz, "On the Synthesis of Neurine." C. G. Wheeler, "On the Action of Aqueous Hypochlorous Acid on Essence of Turpentine and on Camphor.

No. 26.

E. Demance, "On the Amalgamation of Zinc Plates for Voltaic Batteries." P. Van Tieghem, "On the Transformation of Tannic Acid into Gallic Acid by Fermentation."

Sitzungsberichte der koniglich Bayerischen Akademie der Wissenschaften zu München. (Mathematischphysikalische Classe).
March 2, 1867.

Voit, "On the Relations of Creatine and Creatinine to Urea in the Animal Body, and on the Nature of Uræmia.

May 4.

Frischmann, "On Twin Crystals of Chrysoberyl." A. Vogel, "Observations on the Solubility of some Silicates."

July 6.

Seidel, "A Contribution to the Knowledge of the Limits of Accuracy of Chemical Balances." C. Voit, "On the Deposition of Uric Acid from Urine."

NOTES AND QUERIES.

Prussian Blue Paste.—Pure blue, even in paste, provided it be not too thin, will always, when prepared with care, exhibit that particularly coppery gloss which is also possessed by some kinds of indigo of good quality. This property is caused by a peculiar reflection of the light, and appears to have its origin in the peculiar state of aggregation of the particles of these substances, both of which, as is well known, are very difficult to ground to an impalpable powder. As a rule, the Prussian blue of commerce is, in chemical parlance, a mixture of neutral and basic Prussian blue. The coppery gloss is a peculiar property of well made blue, and cannot be brought on by artificial means.

Extraction of Grease by Bisulphide of Carbon.—Can any of your correspondents furnish me with any information upon this subject, or with the name and address of any firm, in this country or elsewhere, who make the apparatus employed for the purpose?—C. L. W.

Production of Carbonic Acid.—I should recommend your correspondent, "G.," to use magnesite, a natural carbonate of magnesia, for obtaining carbonic acid required. The gas obtained by subjecting this mineral in a retort to a red heat, is pure and odourless, and the resulting magnesia will be found more valuable than the original material. But the supply of magnesite is not large.—J. A. X.

TO CORRESPONDENTS.

A. L. Steavenson.—We shall be pleased to hear further from this correspondent on the subject mentioned towards the conclusion of his letter. Such practical experience as he can furnish will be very valuable.

K.—1. Griffin and Sons. 2. Only the firm you have named. 3. Precipitate nitrite of silver by mixing nitrite of potash with nitrate of silver; wash and re-crystallise. 4. Consult the index. 5. We do not remember positively, but in some cases there was a slight colour.

W. S. S. W.—Use gun-cotton instead of powder for blasting the rock; that will enable you to get over the difficulties.

O. George.—This correspondent, who wrote respecting a trade process, is informed that the information can be sent if he will give his private address. We cannot publish it.

Querist.—It is a matter for a lawyer, rather than an editor, to advise about.

Tyro.—The mineral is iron pyrites.

Communications have been received from W. A. Simpson (with enclosure); F. A. Abel, F.R.S.; A. Bird (with enclosure); W. Lant Carpenter (with enclosure); A. A. Fesquet; Dr. A. Adriani; R. C. C. Lippincott (with enclosure); Professor Heaton; W. Blackril; J. M. Reid, Halifax, N.S.; J. Mayer (with enclosure); W. W. Reeves (with enclosure); A. L. Steavenson (with enclosure); W. H. Harrison; Howard Grubb; A. Le Sueur; T. Spencer (with enclosures); W. Bayliffe; J. Wilson; A. Wykes; Dr. Reimann; G. Bird, M.D.; J. Samuelson; H. Williams; T. Reader; J. G. Major; W. A. Smith; E. K. Muspratt; W. J. Morgan; J. E. Taylor; W. Blackie; Ernest Le Barbier; T. R. Fraser, M.D., Halifax (with newspapers); A. Vacher; T. Prentice and Co.; W. Bailey and Son; Harvey and Reynolds; D. W. Edwards; W. C. Deane.

THE CHEMICAL NEWS.
Vol. XVII. No. 438.

ON GUN COTTON TRANSPORT.

The accidents which occurred at Newcastle and elsewhere, in consequence of the disregard of precautions in the transport and handling of nitroglycerine, have created a feeling of distrust in the minds of the traffic managers of railway companies in connection with all explosive substances other than gunpowder. According to the *Pall Mall Gazette*, this distrust has now increased to such a degree that permission is frequently withheld for the transmission by railway even of the compressed gun-cotton charges used for blasting purposes, although the regulations which apply to the transport of gunpowder more than suffice to guard against the possibility of serious accident with gun-cotton.

With the object of investigating the risks incurred in conveyance of compressed gun-cotton charges by railway, Mr. Wilson, of the goods manager's office, North Eastern Railway, in conjunction with Mr. Prentice, the managing director of the Gun-cotton Company, has tried a series of experiments, of which the following is an abstract:—

A small box of cotton containing 125 charges, said to be equal in effects as a blasting agent to a quarter cask of gunpowder, was taken into the cricket field. A fuse was inserted and lighted. When the flame reached the gun-cotton there was a great blaze like the burning of a heap of loose straw, but no explosion; in less than half a minute there was no flame except from the burning of the brown paper in which the gun-cotton had been packed inside the box. The box was of wood about half-inch thick, and was nailed, but not bound with iron at the corners; it was one of the ordinary packages used for sending the cotton out.

Several charges were then laid on the rails near the coal depôts, and coal waggons were run over them: some of them were ignited, others were not. Some of them were placed so that an engine should pass over them, they were all ignited. Mr. Prentice took an axe and chopped one charge into several pieces, there was no explosion or ignition. Small pieces of gun-cotton placed on the iron rim of a wheel and sharply struck with a hammer exploded, or rather detonated.

In all the cases where ignition was produced by concussion, whether of a hammer on iron, or of the wheels of an engine or waggon on the rails, it was very evident that only so much as was actually struck exploded or detonated, tbe part not struck firing from the explosion, and burning like so much straw or flax.

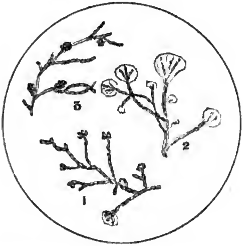
To make sure that they were dealing with the article which produces such an effect when exploded in close confinement, a hole was bored into a large block of hard tough wood, in which Mr. Prentice placed a charge of gun-cotton with a fuse attached to it; he then filled up the hole with broken slate tightly rammed, and fired the fuse. When the gun-cotton exploded the block of wood was shivered to pieces, each piece being blown several yards away.

Mr. Wilson says that the results of these experiments convince him that they may safely carry gun-cotton along with other goods in ordinary waggons, adopting the same rules as now apply to the conveyance of cartridges.

Death by Electricity.—A writer in *Harper's Weekly* recommends a new form of capital punishment. The method is "death by electricity." He says:—"It is perfectly painless and absolutely instantaneous." Another writer says:—"Why is not this in every way preferable, and a thousand times less shameful to a civilised people than the slow strangling now practised upon our criminals?"

ORGANIC APPEARANCES IN COLLOID SILICA OBTAINED BY DIALYSIS.

In the report of the meeting of the Chemical Society held on April 2nd, given in our number for April 10th, we gave a brief account of some interesting observations on the occurrence of "Organic appearances in Colloid Silica obtained by Dialysis." The author of the paper, Mr. W. Chandler Roberts, has kindly forwarded the accompanying drawing of these remarkable appearances, together with some further details.



The dendritic forms in the air-dried gelatinous silica, vary in size from 0·2 to 0·5 millimetre.

When magnified 90 times they appear as radiating fibres; and when magnified 700 times each fibre resolves itself into one or other of the following forms, as shown in the figure:

1. The most common form.
2. The end of each fibre surrounded by an apparently vacuous space indicating its growth in the partially solidified jelly by abstracting water from the mass.
3. Apparent fructification of the organic forms.

ON THE ESTIMATION OF MANGANESE AS PYROPHOSPHATE.

By WOLCOTT GIBBS, M.D.,
Rumford Professor in Harvard University.

The existence of an ortho-phosphate of manganese and ammonium, corresponding to the well-known salt of magnesium, was long since ascertained by Otto.[*] The subject has more recently been studied by Debray,[†] who has described a series of analogous phosphates, all of which are remarkable for their insolubility. Otto's salt, $P_2O_8Mn_2(NH_4)_2 + 2H_2O$, from its highly crystalline structure, the facility with which it is formed, and its insolubility, appeared well adapted to the quantitative estimation of manganese, and the following analyses show that this metal, like magnesium, may be advantageously precipitated as ammonio-phosphate and weighed as pyrophosphate.

To the solution of manganese, which may contain salts of ammonium or of the alkaline metals, disodic orthophosphate is to be added in large excess above the quantity required to precipitate the manganese as orthophosphate. The white precipitate is then to be redissolved in excess of sulphuric or chlorhydric acid, heated to the boiling point, and ammonia added in excess. A white or semi-gelatinous precipitate is produced, which on boiling or standing for some time, even in the cold, gradually becomes crystalline, and finally is completely converted into beautiful talcose scales which have a pearly lustre and a pale rose colour. It is best to precipitate each time in a platinum vessel, in which the ammonia-phosphate may be boiled for ten or fifteen minutes, and to allow the salt to remain at a temperature near the boiling-point of the liquid for an hour after it has become crystalline. The ammonio-phosphate may then be filtered off and washed with hot water. The washing takes place with extraordinary facility on account of the crystalline character of the salt. The orthophosphate, after drying and ignition, yields pyrophosphate of manganese as a nearly white powder. In this manner—

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[*] Bull. de la Société Chimique. Nouvelle Série ii., p. 11.

[†] Ann. der Chemie und Pharmacie, viii., 173.

	Grm.			Grm.				
1.	0·9555	$MnSO_4$	gave	0·8985	$P_2O_7Mn_2$	=46·68	p.c.	MnO
2.	1·1400	,,	,,	1·0717	,,	=46·67	,,	,,
3.	0·8145	,,	,,	0·7646	,,	=46·63	,,	,,
4.	0·9464	,,	,,	0·8886	,,	=46·66	,,	,,
5.	1·3181	,,	,,	1·2390	,,	=46·68	,,	,,
6.	1·0565	,,	,,	0·9950	,,	=46·76	,,	,,

The formula requires 46·67 per cent ($Mn = 54$). The sulphate employed was pure and perfectly anhydrous. In two analyses of crystallised chloride of manganese, not quite free from mechanically mixed water, Mr. F. W. Clarke obtained 27·08 and 27·07 per cent of manganese. In the same salt the percentage of chlorine was found to be 35·68, which corresponds to 27·14 per cent of manganese.

The advantage of this method over that commonly employed for the estimation of manganese, is that the process permits us to weigh the metal in the form of a perfectly definite compound, and not as an oxide which cannot be safely assumed to consist wholly of Mn_3O_4. When manganese is associated with the alkaline earths, it is of course first to be separated as sulphide, or by Schiel's method, as a hydrate of the sesquioxide. The ammonio-phosphate is almost absolutely insoluble in boiling water, in ammonia, and in solutions of salts of ammonium. The salt is nearly white, but sometimes becomes a little more red upon the filter. If it assumes a rather deep dull red colour, the whole of the phosphate of manganese has not been converted into ammonio-phosphate. The precipitate is then to be redissolved in dilute chlorhydric acid, more phosphate of sodium added, and then ammonia in excess, after which the boiling is to be repeated. This repetition is very rarely necessary, a little practice enabling the analyst to judge when the conversion from the flocky-gelatinous to the crystalline condition is complete. The filtrate from the crystalline salt is perfectly free from manganese. Phosphoric acid cannot be determined by precipitation, as ammonio-phosphate of manganese, because the crystalline character of the salt upon which the success of the process depends is only produced by digestion with an excess of phosphate. Bette‡ has described an ammonio-phosphate of zinc which, like the corresponding manganese salt, is almost absolutely insoluble in water. Debray‖ has analysed similar salts of nickel and cobalt; and Otto§ has also described the analogous ammonio-phosphate of iron. I have myself prepared an ammonio-phosphate of cadmium which, like the other salts of this group, is extremely insoluble in water. All of these salts, however, are more or less readily soluble in ammonia and in salts of ammonium, and after repeated trials I have not succeeded in rendering any of them available for analytical purposes.—*Am. Journ. Science.*

ON THE

DETECTION OF METHYLATED SPIRITS BY CHEMICAL REACTIONS.*

By Dr. J. W. GUNNING, Professor of Chemistry at the Athenæum Illustre at Amsterdam, and Scientific Adviseur to the Netherlands Ministry of Finance.

(Concluded from page 187.)

Inasmuch as there might be present in an alcoholic fluid which one should desire to test in the manner described, non-volatile organic substances which would interfere with the proper action of the reagents, it is clear that the non-volatile should be removed by previous careful distillation, while, as regards the volatile organic substances, their disturbing influence may be judged from the following experiments, made by adding to 5 c.c. of pure alcohol a few drops of the undermentioned substances, and after having well mixed these with the alcohol, the reagents have been added in the usual manner, viz., mercurial solution, ammonia, and caustic potassa.

Amyl alcohol.—With 3 drops, no sensible difference, *i.e.*, the reddish-brown precipitate ensues as with pure alcohol; with 10 drops, the precipitate gets a decidedly yellow tinge.

Acetic Ether.—With 3 drops [let it be understood, 3 drops of the ether added to 5 c.c. of pure alcohol], but with addition of half the bulk of the pure alcohol of ether, a reaction ensues, as if a very small amount of wood spirit were present, viz., a faint yellowish opalescence.

Valerianate of Amyl.—(A dilute solution in pure alcohol was applied.) With 10 drops thereof added to 5 c.c. of pure alcohol a reaction ensued, as if a very small amount of wood spirit was present.

Pine Apple Essence.—Reaction as the last foregoing, but less strongly marked.

Essential Oils.—Eau de Cologne, *i.e.*, the same made with non methylated spirits, yields the same reaction as pure alcohol, but the precipitate is more yellow-coloured. If to 5 c.c. of eau de Cologne, 2 drops of wood spirit [not methylated spirit, of course] are added, there ensues no precipitate at all, and at the utmost, a faint opalescence. Larger quantities of essential oils than are met with in scented waters disturb the action of the reagents in a far higher degree. Alcohol mixed with from 4 to 6 per cent of oils of lavender, rosemary, entirely prevent the formation of any precipitate, and act therefore as wood spirit does. Oil of turpentine exerts the same action but in a somewhat less degree.

Sulphuric Ether.—The same reaction as if a small quantity of wood spirit were present.

Aldehyde, i.e., in this case the crude distillate obtained on treating alcohol with bichromate of potassa and sulphuric acid, acts as wood spirit, *i.e.*, no precipitate ensues.

Spiritus Nitri dulcis.—No precipitate.

Muriatic Ether.—The same reaction as wood spirit.

Chloroform exercises no influence *i.e.*, the reddish brown precipitate is formed.

Benzol exercises a slight influence; the precipitate is somewhat yellow.

Amylen exercises a very marked influence the reaction is the same as if a small quantity of wood spirit was present.

These experiments prove that there are some substances which interfere with and more or less disturb the reaction for wood spirit; some of these substances act indeed as if wood spirit itself were present, while others again hinder the reaction, and modify the colour of the precipitate due to pure alcohol only.

As regards the first batch of these disturbing substances, there is no real difficulty to detect them, neither is there the least difficulty to eliminate them from a fluid which it is desirable to test; for distillation with caustic potassa, followed by treating the distillate, previously diluted with water, with animal charcoal will have the desired effect, while if aldehyde is present, as for instance in the case of spiritus nitri dulcis, a separate distillation with ammonia is required to fix the aldehyde.

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‡ Ann. der Chemie und Pharmacie, xv., 129.

‖ Loc. cit.

§ Ann der Chemie und Pharm., xvi., 199.

* Translated from the Dutch by A. Adriani, M.D., Ph.D., &c.

As regards the second batch, viz., the essential oils, if present in rather larger quantity in an alcoholic fluid which one should desire to test for wood spirit, they may be reduced to small traces by the application of the following expedient manipulation. Mix the alcoholic fluid in question with as much magnesia alba, the ordinary magnesia of the chemist's shops, as will yield a thick magma, next add twice the bulk of the alcohol of a thoroughly saturated aqueous solution of common salt, and then bring this whole mixture on a filter previously filled with magnesia; the perfectly clear filtrate is next submitted to distillation, the first small portion of the distillate, which yet will show turbidity on becoming mixed with water, is set aside, and the remainder of the distillate can then be applied to be tested for wood spirit. I ought to observe here, that if an alcoholic fluid which contains wood spirit is submitted to fractional distillation, all portions of the distillate will yield pretty fairly an equal amount of wood spirit.

The experience I have acquired by the opportunity offered to me, especially of testing on a large and ample scale divers alcoholic fluids, enables me to state that chemists will find the test described by me quite reliable to speak of, or discern with certainty the presence or absence of wood spirit in an alcoholic liquid submitted to examination. But I must expressly say that in the strictest sense the reagent only applies to aceton, and it is, therefore, only then permitted to draw the conclusion that wood spirit is really present when also the smell and other concomitant phenomena justify this conclusion. The administration of the excise in the kingdom of the Netherlands, *vulgo* Holland, does not allow wood spirit to be used for making methylated spirit, *i.e.*, mixing with alcohol, unless the wood spirit has been previously submitted to the following test: 1 part by volume of wood spirit mixed with 99 parts by volume of pure and absolute, *i.e.*, anhydrous alcohol, must be very plainly and readily recognised by the reagents above described. If there might be a doubt, or also in cases where it might be of great importance, I think the experiment by oxidation ought not to be omitted; for this reason I will briefly allude to it yet. I proceed in the following manner: 97.5 grammes of bichromate of potassa are mixed with 146·25 grammes of sulphuric acid previously diluted with 775·35 grammes of water; 35 c.c. of this fluid is mixed with 4 c.c. of the alcoholic fluid to be submitted to experiment, and placed in a small retort; the mixture while in the retort is left to itself for 24 hours, and then about 4-5ths of the contents of the retorts (several experiments of this kind are conducted at the same time, and also with mixtures of known purity) is distilled off, care being taken to keep all under the same conditions. The distillate is mixed with magnesia and evaporated. The reason why I prefer magnesia to carbonate of soda is, that the latter acts upon the aldehyde of the distillate; in consequence whereof the residue of the evaporation is rather strongly coloured, and consequently apt to reduce more of the alkaline solution of permanganate of potassa than can be accounted for by the quantity of formiate of soda which is formed. When magnesia is applied, the residue of the evaporation remains colourless even when the process of heating upon a water bath is very greatly prolonged, which is always required when essential oils are to be entirely eliminated. The residue of the evaporation is next taken up with distilled water, and then mixed with excess of an alkaline solution of permanganate of potassa of precisely known strength, *i.e.*, oxidising power, and left for at least two days quietly standing; the solution of permanganate is, after that time, tested by the well known method. I found it necessary to have two days' rest, as by experiments purposely instituted with a small quantity of pure formiate of soda, I found out that even up to 48 hours after the beginning of the experiment the titre of the permanganate had only become constant.

The following are results obtained with the described mode of proceeding:—

		Quantity of oxygen required to oxidise the formic acid formed.	
	First Series.		
Pure alcohol		1·2	milligrammes
"	"	1·6	"
"	+ 1 per cent wood spirit	2·6	"
"	+ 3 "	5·2	"
"	+ 5 "	8·3	"
	Second Series.		
Eau de Cologne		2·7	"
"		2·4	"
"	+ 2 per cent wood spirit	6·9	"
"	another variety	6·2	"
"		6·4	"
"	+ 1 per cent wood spirit	9·2	"
"	"	10·1	"
	Third Series.		
Pure alcohol		0·7	"
"		1·1	"
Methylated spirit		17.0	"
"		12·0	"
Eau de Cologne		4·4	"
"		4·0	"
"	made with methylated spirit	26·0	"

The above-mentioned results of experiments by oxidation may be left to tell their own tale, but it will be seen that as regards the disturbing influence of essential oils especially, the checking of the experiments by simultaneously making the experiment with alcohol of known purity, is desirable.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 16, 1868.

DR. WARREN DE LA RUE, F.R.S., &c., President, in the Chair.

THE minutes of the previous meeting were read and confirmed. Amongst the donations to the library was the new catalogue of scientific works recently prepared by order of the Royal Society.

Dr. F. GUTHRIE was formally admitted as a Fellow, after having signed the statute book. No new candidates were proposed, but the name of Mr. Thomas Bournes, Teacher of Chemistry, 47, Rigby Street, St. Helen's, Lancashire, was read for the second time. The ballot was taken on behalf of Lieutenant Francis C. H. Clarke, Royal Artillery, Staff College, Farnborough Station, who was declared to have been duly elected as a Fellow of the Society.

PROFESSOR GUTHRIE described and exhibited an *Improved Voltastat*, by which the current of a galvanic battery may be maintained perfectly constant and regular by a self-acting arrangement, which will become intelligible by the following description:—A vertical glass cylinder of about the size of a test tube is charged with dilute sulphuric acid, with a layer of mercury below occupying about one-third of its total contents. Partly immersed in the acid liquid is a pair of platinum electrodes insulated by glass fused upon the wires at that portion which passes through the cork stopper of the jar, and a comparatively wide glass tube open at both ends is fixed in the same cork, with its lower extremity dipping below the level of the mercury, whilst another delivery tube with bulb and capillary orifice provides for the slow escape of the mixed gases resulting from the electro-decomposition of the water. This apparatus having been placed in the battery circuit, say of three Bunsen cells, evolves the oxyhydrogen gas with a rapidity which may be easily regulated by the size of the aperture; if, then, the activity of the battery is increased, the larger volume of gas, unable to escape, exerts a greater degree of pressure upon the liquid contents of the cylinder, and the mercury is forced up the open tube, whereby the column of liquid descends and smaller surfaces of the platinum plates are left immersed, and the power of conduction is to a corresponding extent lessened. In this manner the author states that he found no difficulty in maintaining a perfectly uniform current for a period of six or seven hours, and any required adjustment could be made either by altering the size of the apparatus or of its component parts. By collecting the gases evolved this little arrangement could also be made to serve as a voltameter.

The President, in remarking upon the ingenuity displayed in the construction of the apparatus, suggested that, whilst it would be found serviceable in electroplating and other applications where a somewhat intense current was employed, he doubted its use in the ordinary electrotype process for the deposition of copper, where weak currents only were required.

Professor Guthrie then proceeded to read his paper "*On Graphic Formulæ*," which at the outset he stated to be founded on the same general principle as that of Dr. W. Crum Brown, but would, he conceived, "serve to illustrate the molecular constitution of compound bodies from a somewhat different perspective." The author adopts a new set of pictorial symbols by which to represent the elements themselves, and arranges them in a geometrical fashion to construct the compounds formed by their union. Thus hydrogen in combination is expressed by a single dot, the gas itself by two dots; chlorine, by a pot-hook; iodine, by a small triangle; bromine, by a cross like the sign of multiplication; fluorine, by a couple of commas. Bivalent elements, thus: oxygen, a horizontal dash; sulphur, a waved line; selenium, like sulphur, but more angular. Trivalent elements: nitrogen, a large triangle; phosphorus, similar, but with lines curved inwards. Carbon is designated by a square or four-sided figure. If then, marsh gas has to be represented, the carbon atom is shown to be saturated by placing a dot, for hydrogen, outside each face of the square. In a similar manner, with ammonia, the triangle of nitrogen has a dot standing off each face. Water is a dash with dots, for hydrogen, above and below; sulphuretted hydrogen, a waved line with two dots similarly placed; hydrobromic acid, a dot and a cross; nitrous oxide, two triangles with a horizontal dash placed between them, the whole figure being placed in a symmetrical (vertical) form; nitric oxide, a single triangle with dash below; and nitric anhydride, two triangles separated by a dash, and having all disengaged faces closed in by the oxygen dash. As yet no specific symbols are proposed for the metallic elements; but the author, later in the evening, adopted for mercury the present crossed sign for that metal. By way of conclusion, Professor Guthrie drew the figure representing triethylamine, which was shown with nitrogen (a triangle) for the nucleus, with a couple of outstanding carbon squares, appropriately dotted, opposed to each face of the triangle. The author claims for his system an increased facility in representing the satisfied and unsatisfied polarities of compound bodies.

Drs. Atkinson, Russell, and Stevenson spoke briefly, and, in a general sense, adversely, as to the desirability of introducing the system to the notice of the student. The last-named gentleman considered that the new symbols would afford little or no help in elucidating the constitution of bodies beyond the methods at present in use, and they would only be to the student something more to learn.

Dr. Odling regretted the absence of Dr. Frankland, who was so warm an advocate of the policy of introducing these pictorial methods of representation. For his own part, he looked upon them much in the light of "picture alphabets," and applicable only to those who, like the juveniles, could not be brought to book without such fascinating aid. His objection, both to this and to the system of Dr. Crum Brown, was that it required the eye of an artist to show the figures to advantage, and even then they might not be arranged properly. There were two ways, for instance, of representing the constitution of *white precipitate*, HgCl, NH_2. According to one view, the mercury was made the central atom around which the affinities were severally disposed; but if nitrogen was placed as the nucleus of the system, then we arrived at the anomalous result that chlorine was directly united with it, and mercury even with a double bond; whereas the known properties of the elements would rather point to hydrogen and mercury as those for which the chlorine had the strongest affinity. Dr. Odling humourously remarked that this difficulty could be met in a manner similar to that of a "diplomatic student" at one of the Cambridge examinations, who, when asked whether the sun moved round the earth, or otherwise, answered by saying that "sometimes it went one way and sometimes another."

At the request of the President, Dr. Guthrie sketched upon the board his mode of representing the constitution of *white precipitate*; but two efforts were required before an expression was arrived at which met with general approval.

Dr. J. H. Gladstone then read a paper "*On the Tetraphosphoric Amides*." These compounds are produced by the action of water upon the amidated oxychlorides of phosphorus, and contain, as their name implies, four atoms of phosphorus united with the other elements in what at first sight appeared extremely complex relations. Their physical condition renders them somewhat difficult of purification—most of them being "sticky flocculent precipitates,"—and it is not to be wondered at that the analytical results are not so sharp and satisfactory as with bodies which can be purified by crystallisation. Amongst the substances described by Dr. Gladstone, are the terammoniated tetraphosphodiamic acid, $P_4N_5H_{17}O_{11}$, viewed thus:—

$$P_4(NH_2)_2(NH_4)_3HO_{11}$$

and a solid acid, to which the undermentioned name and formula apply,

Tetraphospho-tetramic acid, $P_4N_4H_{10}O_9$, viewed as

$$P_4(NH_2)_4H_2O_9.$$

Two silver salts of this acid were prepared, in one of which six atoms of the hydrogen were replaced by the metal.

The President, in reference to the highly complex character of the bodies described by Dr. Gladstone, ventured to suggest that some of those now considered to be individual substances might ultimately prove to be mixtures of simpler and more definite compounds.

Mr. W. H. Perkin saw no inconsistency in the formulæ proposed by Dr. Gladstone; these bodies were constituted on the type of Professor Wurtz's polyethylic alcohols in which the ethylene was replaced by phosphorus compounds.

A paper by Mr. J. Carter Bell was next read. It was entitled, "*On the Solubility and Crystallisation of Plumbic Chloride in Water, and in Water containing various proportions of Hydrochloric Acid.*" The author finds the degree of solubility in pure water to be somewhat greater than hitherto represented, the mean experimental result gave 1 part in 121 parts of water, instead of 135. By boiling with water there is evidence of decomposition resulting in the formation of free hydrochloric acid with oxide of lead, or a basic salt, left in solution. The solubility of the chloride in hydrochloric acid decreases until the amount of acid reaches 15 per cent, when the curve again ascends to a maximum with the pure acid. The author concludes with some observations upon the different forms of crystals obtained by the evaporation of aqueous and hydrochloric solutions.

A vote of thanks having been passed to the authors of the above communications, the meeting was adjourned until Thursday, May 7th, when Mr. Siemens will deliver a discourse "*On the Regenerating Furnace as applied to the Production of Steel.*"

PHILOSOPHICAL SOCIETY OF GLASGOW.

CHEMICAL SECTION.

The usual fortnightly meeting of this section was held in the Philosophical Society's Hall, on Monday evening last; Alexander Whitelaw, Esq., Treasurer, in the chair. After the election and admission of a number of new associates, a paper on "*The Estimation of Potash*," by Messrs. James Chalmers, chemist to the Kames Gunpowder Company, and Robert R. Tatlock, F.C.S., analytical chemist, Glasgow, was read to the Section. The authors urged that the subject was of much greater importance than the title would seem to indicate. Glasgow and its vicinity form the chief seat of the manufacture of potash salts from kelp, and form the destination of almost all the muriate of potash now manufactured from the interesting deposit in the vicinity of Stassfiirth, as well as of the potash salts largely made from French beet-root; and as the value of these salts is fixed by the amount of potash they contain as determined by chemical analysis, it is obvious that in Glasgow, at least, an accurate and uniform method of estimating that base is of the utmost importance, as an indispensible adjunct to the manufacture and sale of potash salts. That such a desideratum had long since been supplied might well be supposed from the various methods of analysis described by eminent authorities, and from the results of the experience of many able chemists who have necessarily been much engaged in the analysis of potash salts. But unpardonable discrepancies constantly occur with regard to the results obtained by chemists of standing and experience, even when operating on the same carefully mixed and uniform sample; and these point to the conclusion that either the instructions given by those who may almost be regarded as infallible authorities have been misunderstood, and but imperfectly carried out, or, that in many instances, the details of the methods as laid down are so imperfect as to be useless, if not even misleading.

The experience of the authors of the memoir, in the analysis of potash salts, has extended over a period of many years, during which they have conjointly made thousands of potash estimations, and hence they urge that they may be fairly entitled to claim some acquaintance with the subject.

By long and careful attention to the results obtained by other chemists, confirmed by their own experience, the authors have invariably found that the general tendency is to report potash too high, and the object of the paper was not only to trace the cause of this seemingly constant error, but also to furnish from the results of a laborious and protracted course of experiments, the true means of obviating that tendency, and obtaining not only constant, but, so to speak, absolutely correct results. In the analysis of salts not particularly rich in potash compounds, a too high result is most frequently obtained, but escapes detection under cover of the extraneous salts present,—the blame of the excess of potash reported being thrown upon the soda salts, which are not directly estimated. This error is usually discovered only when approximately pure salts are under investigation, when the analysis comes out impossibly high. It is almost superfluous to remark that any process which does not give from 99·9 to 100·15 per cent with pure salt, is totally inadmissible. The authors have both a conviction and a positive assurance that the methods adopted by chemists—at least such methods as have come under their observation— do not give results so close to the truth as those just quoted; and it is from this reason that they were induced to investigate the whole subject, and bring the results of the investigution under the notice of the Section.

They admit that such remarks may seem to involve rather strong and severe strictures on experienced analysts, and that such strictures should not be hastily made when the accuracy and definite nature of modern chemical analysis are considered; but on finding differences of from 1 to 2 per cent by different analysts, and results giving a total of 100 per cent in a muriate of potash from the potassic chloride and water alone, while soda salts, insoluble matter, and sulphate of potash—a salt having a higher equivalent than potassic chloride—were ignored, they felt warranted in saying that serious errors were made. They claim no superior sagacity in chemical matters, but simply affirm that their positions and other circumstances directed their attention to the subject, and compelled them to investigate it. The errors and conflicting results are not necessarily the consequence of careless analysis or manipulation, but are chiefly due to an unsuspected source of error in the reagent employed. That these defects in "potash analyses" have so long escaped investigation, and even general observation, is perhaps owing to an unaccountable and mistaken reliance in what is generally called a "full analysis" of a muriate or other potash salt. In many cases of full analyses of compounds, when the sum of the various determinations amounts to 100 per cent, or very nearly, the analysis is general accepted as trustworthy, and deservedly so if each of the ingredients or elements is estimated separately, and not calculated from the amount of another element; yet still, in the analysis of a commercial potash salt results approaching a total of 100 per cent give no reliable check on the accuracy of a potash determination, as there is no *practical* method of determining soda, even indirectly, in presence of potash. After enlarging on the methods of estimating soda in presence of potash, the authors considered the general subject under the following heads:—

I. The chemical principles involved in the methods employed.

II. The manipulation of the process.

III. The calculation of results.

I. The authors regard the familiar method of determining potash in presence of soda—the one now almost exclusively practised, namely, that of precipitating potash as potassio-platinic chloride—as being superior to all others; but the details of it, as laid down in some analytical works, appear to the authors too meagre for guidance to correct results; and, indeed, with the exception of the writers of a few scattered notes, they know of no chemical authors, except Fresenius, who habitually subject analytical processes to a searching examination. The directions generally given are—to evaporate the potash solution to dryness with excess of platinic chloride, and to digest the residue in alcohol before filtering. As this treatment is inapplicable to salts containing an appreciable amount of soda, most practised analysts avoid this source of error, by stopping the evaporation somewhat short of dryness, and digesting the residue in strong aqueous solution of platinic chloride, which dissolves sodium compounds, but practically leaves the potassium precipitate intact. This process is capable of giving very correct results, if all the other essential points are attended to. Of the other conditions requisite to ensure accuracy, the most important is the purity of the platinic chloride solution; indeed, the authors regard this as the key-stone of the entire process—impure platinum and false results being as inseparably associated as crime and punishment. As pure platinic chloride solution is not the rule, but the rare exception, false results must be alarmingly numerous; and as most, if not all, of the methods usually followed in recovering platinum from spent solutions and precipitates are the means of introducing impurities that are not easily removed, the authors first briefly noticed those methods, and the objections to them, as founded on numerous trials made by themselves. The usual methods are four in number:—

1st. Reduction by nascent hydrogen produced by the action of zinc on dilute hydric sulphate.

2nd. Reduction by alcohol in presence of excess of sodic hydrate.

3rd. Reduction by cane sugar, or by glucose, in a solution strongly alkaline by sodic carbonate.

4th. Reduction by ignition of the precipitated and evaporated fluid washings in a Hessian or other crucible, as recommended by Miller, Abel, and Williams.

The authors tried all these methods most extensively, testing the platinic solution in the most rigorous way by making repeated estimations with perfectly pure potassic chloride. They used the compound sold by Griffin as chemically pure, but further purified it by successive crystallisations from distilled water. It contained the normal amount of chlorine; fluorine was sought for but not found. Solution of platinic chloride was prepared from Johnson and Matthey's spongy platinum, boiled in nitric acid, and washed before dissolving. This solution gave with pure potassic chloride results bordering on 102 per cent, using the equivalents accepted by certain practical authorities; nor could these results be brought much nearer the truth. This was certainly an alarming state of things, and showed that ordinary spongy platinum is not in a fit state for preparing pure platinic chloride.

Using the first method of recovering platinum, the authors found that if commercial zinc was employed, pure potassic chloride gave with the platinic chloride results far too high. They averaged from 101·67 to 102·05 per cent. Using purified zinc, Griffin's best, sold as being free from arsenic, and for use in Marsh's test, but giving distinct indications of the presence of cobalt, the results were nearer the truth, but still too high, being from 101·37 to 101·58 per cent. The chief objection to this method is the great difficulty of procuring zinc free from lead. On one occasion one of the authors obtained a crop of chloride of lead crystals, weighing upwards of 90 grains, from the accumulated insoluble matters left on the filters during the filtration of platinic chloride solution prepared from the metal recovered by the zinc method.

It is the second method, or rather a modification of it, which the authors have used for some time in the recovery of platinum to be used in the analysis of commercial potash samples. They render the solution of platinum waste strongly alkaline by sodic hydrate, and boil with alcohol. The resulting platinum black is further purified by boiling in dilute nitric acid and soda solution, with intermediate and final washings with water. Thus prepared, the platinum invariably gave high results. The following are examples, pure potassic chloride and recognised factors being used:—101·77 to 101·95 per cent, and 101·12 to 101·24 per cent, according to the degree of purification by the acids.

The third method, as recommended by Böttger,* did not give pure platinum. The authors used both glucose and common white cane sugar. One set of analyses gave, with pure potassic chloride, from 101·3 to 101·6 per cent. In a second set—the purifying being carried to a prolonged degree—the results were from 100·76 to 100·94 per cent. To a certain extent, the authors deemed these results to be satisfactory; but if calculated by Stas's equivalents, they gave from 101·22 to 101·4 per cent. In this series of trials, carefully made—the manipulation being unchallengeable,—there were only four cases in which fair results were obtained with pure salts, by using platinic chloride prepared from platinum which had not been previously ignited to remove organic matter.

The authors deem the fourth method to be imperfect from the great difficulty of completely decomposing the potassio-platinic chloride. Simple ignition being insufficient, ignition along with nitre was tried. In some of the experiments with platinum thus obtained the following percentages were given:—100·03, 100·11, 100·16, and 100·22; but the results were always high when using less than four drachms of water to dissolve the precipitated muriate.

Many experiments—some detailed by the authors—were performed in duplicate in order to determine the best method of reduction and purification of the platinum. But very early in their inquiry they were led to suspect other sources of error: these they also investigated, and ultimately obtained results varying from 100·08 to 100·001, which are certainly satisfactory alike to science and commerce.

II. In respect of the manipulation of the process the authors object to the method of operating on such a small quantity as 10 grs., as it gives inconstant and unreliable results. (1.) Any error of the balance is greatly multiplied in calculating to per cent. (2.) The whole of the insoluble matter is necessarily included in the weight of the potassio-platinic chloride, or, worse still, the small quantity must be dissolved and filtered, and the solution evaporated.—a most tedious and unsatisfactory mode of procedure. (3.) Electrical repulsion in dry and freshly wiped watch-glasses used in weighing, frequently causes a loss of the dried powder, and such powder is always hygrometric, and thus errors may occur in two ways. (4.) The amount dried from which the sample is taken is too small. The authors prefer to follow the advice of Fresenius and other authorities, and take, say, 500 grs., which they dissolve in a small quantity of water. They filter the solution into a 5,000 gr. flask which they fill up to the proper level with the washings and water at 60° Fah., and by means of a graduated pipette they remove for precipitation an aliquot part of the whole solution. In their paper the authors detailed the mode of performing the volumetric operations, and replied to the objections raised to the use of the pipette, and gave some details regarding actual pipette measurements. One of these was 99·97 volumes of water delivering 100 volumes of muriate solution.

III. It is not enough to master the methods of obtaining pure platinic chloride, and to manipulate the analysis of a potash salt correctly, as error would still result if wrong equivalents or incorrect factors be used for calculating the results. The authors have found that some chemists of high standing and experience in practical analysis use factors which are not only not based upon exact experiments, but give results from ·5 to ·75 per cent too high when using pure potassic chloride, and when every other step in the process is rigidly correct. They then give the equivalents of platinum, potassium, and chlorine, as used by various authorities, and regard as most trustworthy those given by Stas, at the mention of whose name in connection with combining numbers, they suggest that every good chemist should cross himself and look devout. They said they would like to know where the factors ·194 and 1·585, as used by some analysts, were obtained. Those used by the authors are ·1925 and 1·584, and are based on Stas's numbers. No others, in their opinion, will give correct results, seeing that they have been determined with every refinement of which modern science is capable.

The final conclusions arrived at by the authors are:—

1. That the methods of analysis taught and practised in some laboratories are very imperfect.

2. That the use of the factor ·194, or any others than those founded on Stas's equivalents, is erroneous, and not based on reliable experiments.

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* Chemical News, vol. xi., p. 168.

3. That it is necessary to check the process used, and to be satisfied of the purity of reagents and other disturbing causes, by experiments with pure potassic chloride or other potassium salt; and that in no case should results be reported unless controlled by such experiments.

In the discussion which followed the reading of the paper, several members having much experience in potash analysis, supported the views of the authors, and highly complimented them upon the extraordinary industry displayed in the elaborate series of experiments referred to in the paper, and on the rigid care taken to avoid all sources of error. Messrs. Chalmers and Tatlock were heartily thanked for their interesting and valuable communication.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, March 31st, 1868.

Edward Schunck, Ph.D., F.R.S, &c., President, in the Chair.

"*Microscopic Examination of the Solid Particles from the Air of Manchester*," by J. B. Dancer, F.R.A.S.

The air had been washed in distilled water, and the solid matter which subsided was collected in a small stoppered bottle, and on the 13th of this month Dr. Smith requested me to examine the matter contained in this water. An illness prevented me from giving it so much attention as I could have wished.

The water containing this air-washing was first examined with a power of 50 diameters only, for the purpose of getting a general knowledge of its contents; afterwards magnifying powers varying from 120 to 1,600 diameters were employed.

During the first observations, few living organisms were noticed; but, as it afterwards proved, the germs of plant and animal life (probably in a dormant condition) were present.

I will now endeavour to describe the objects found in this matter, and begin in the order in which they appeared most abundant.

1st. *Fungoid Matter.*—Spores or sporidiæ appeared in numbers, and, to ascertain as nearly as possible the numerical proportion of these minute bodies in a single drop of the fluid, the contents of the bottle were well shaken, and then one drop was taken up with a pipette; this was spread out by compression to a circle ½ an inch in diameter. A magnifying power was then employed, which gave a field of view of an area exactly 100th of an inch in diameter, and it was found that more than 100 spores were contained in this space; consequently the average number of spores in a single drop would be 250,000. These spores varied from 10,000th to 50,000th of an inch in diameter. The peculiar molecular motion in the spores was observable for a short time, until they settled on to the bottom of the glass plate; they then became motionless.

The Mycelium of these minute fungi were similar to that of rust or mildew (as it is commonly named), such as is found on straw or decaying vegetation.

When the bottle had remained for 36 hours in a room at a temperature of 60° the quantity of fungi had visibly increased, and the delicate mycelial thread-like roots had completely entangled the fibrous objects contained in the bottle and formed them into a mass.

On the third day a number of ciliated zoospores were observed moving freely amongst the sporidiæ. I could not detect any great variety of fungi in the contents of the bottle, but I cannot presume to say that all the visible spores belonged to one species, and as there are more than 2,000 different kinds of fungi it is possible that spores of other species might be present, but not under conditions favourable for their development. Some very pretty chain-like threads of conidia were visible in some of the examinations.

The next in quantity is vegetable tissue. Some of this formed a very interesting object, with a high power, and the greater portion exhibited what is called pitted structure. The larger particles of this had evidently been partially burnt and quite brown in colour, and were from coniferous plants, showing with great distinctness the broad marginal bands surrounding the pits; others had reticulations small in diameter. They reminded me of peforated particles so abundant in some kinds of coal.

The brown or charred objects were probably particles of partially burnt wood used in lighting fires.

Along with these reticulated objects were fragments of vegetation, resembling in structure hay and straw and hay seeds, and some extremely thin and transparent tissue showing no structure. These were doubtless some portions of weather-worn vegetation. A few hairs of leaves of plants and fibres, similar in appearance to flax, were seen, and as might have been expected in this city, cotton filaments, some white, others coloured, were numerous; red and blue being the predominant colours. A few granules of starch, seen by the aid of the polariscope, and several long elliptical bodies, similar to the pollen of the lily, were noticed. After this dust from the atmosphere had been kept quiet for three or four days, animalculæ made their appearance in considerable numbers, the monads being the most numerous. Amongst these were noticed some comparatively large specimens of paramecium aurelia, in company with some very active rotiferæ; but after a few days the animal life rapidly decreased, and in twelve days no animalculæ could be detected.

Hairs of Animals.—Very few of these were noticed, with the exception of wool; of this both white and coloured specimens were mixed up along with the filaments of cotton.

After each examination as much of the drop of water as could be collected by the pipette was returned to the bottle, in order to ascertain if any new development of animal or vegetable life would take place, and the stopper of the bottle was replaced as quickly as possible to prevent the admission of the particles from the air in the room; and I am tolerably certain that the objects named in this paper are those which the bottle contained when Dr. Smith brought it to me.

The particles floating in the atmosphere will differ in character according to the season of the year, the direction of the wind, and the locality in which they are collected, and, as might be expected, are much less in quantity after rain.

The small amount of fluid now remaining in the bottle emits the peculiar odour of mildew, and at present the fungoid matter appears inactive.

For the purpose of obtaining a rough approximation of the number of spores, or germs of organic matter contained in the fluid received from Dr. Smith, I measured a quantity by the pipette, and found it contained 150 drops of the size used in each examination. Now, I have previously stated that in each drop there were about 250,000 of these spores, and as there were 150 drops, the sum total reaches the startling number of 37½ millions, and these, exclusive of other substances, were collected from 2,495 litres of the air of this city*—a quantity which would be respired in about 10 hours by a man of ordinary size when actively employed. I have to add that there was a marked absence of particles of carbon amongst the collected matter.

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* Behind Dr. R. Angus Smith's laboratory.

FOREIGN SCIENCE.

Paris, April 21, 1868.

Ferments present in commercial bicarbonate of soda.—Action of saline solutions on minerals.—Detection of arsenic in cases of poisoning.—Academy of Sciences:—A new bank paper.—Reaction of sulphuric acid upon iodide of potassium.—Mode of development of heat and cold.

M. Le Ricque de Monchy has published a note on organised ferments which occur in commercial bicarbonate of soda. He has observed in all unfiltered, concentrated solution of this substance, that he has yet examined with the microscope, very small moving corpuscles, commonly designated molecular granulations; these vegetable cells or their germs can only come from the atmosphere, where they were in suspension, since it is not conceivable that organised matter should withstand the high temperature to which soda in manufacture is submitted. The corpuscles only appear after the manufacture, and their presence explains the production of vegetable matter in media, where one is surprised to meet with it; they are ferments, the action of which varies with the surrounding matter; in certain cases they are producers of alcohol.

M. Terreil has studied for a considerable time the action of different saline solutions on minerals with a view of discovering methods of proximate analysis. At a recent meeting of the Academy, he made known the results already obtained in this direction, the note had reference chiefly to the action of ammoniacal salts upon the natural carbonates. The carbonates of baryta, strontia, and lime are easily decomposed by solutions of ammoniacal salts, with the exception of carbonate of ammonia, which leaves them in the state of carbonates. When the acid of the salt, with the base of the carbonate, gives rise to a soluble compound, the decomposition is more rapid. Carbonate of baryta is more easily attacked than carbonate of strontia, and the latter more easily than carbonate of lime. Baryta and strontia are separated in treating the two carbonates with a mixture of chlorhydrate and chromate of ammonia; the strontia is dissolved, and the baryta remains insoluble in the form of chromate. The separation of lime from baryta and strontia is effected with sulphate of ammonia, which transforms the three carbonates into sulphates; the sulphate of lime, which is more soluble in the solution of ammoniacal salt than in water, is dissolved, while the sulphates of baryta and strontia remain insoluble. Carbonate of magnesia is rapidly attacked by ammoniacal salts, as well as by carbonate of ammonia, which dissolves it, although slowly; this property enables the separation of magnesia from the preceding bases to be effected, by treating the mixture of these carbonates by chlorhydrate and carbonate of ammonia, renewing the latter salt as fast as it is volatilised. The carbonate of manganese comports itself with ammoniacal salts like the carbonate of magnesia, rendering the separation by mere solvents a difficult matter, but by adding a few drops of sulphydrate of ammonia to the boiling solution of the carbonates in chlorhydrate of ammonia, the sulphide of manganese is precipitated almost completely. M. Terreil draws attention to the fact that when sulphydrate of ammonia is added to a solution containing besides manganese, a considerable quantity of ammoniacal salts, the sulphide of manganese is only precipitated after prolonged ebullition; his experiments have shown that of all ammoniacal salts, the oxalate is the one which most impedes the precipitation of the sulphide of manganese.

The natural carbonate of iron, under the influence of ammoniacal salts, is converted into a salt of iron; the decomposition is slower than in the case of the carbonates already referred to. Under these circumstances, the iron salt produced is in the lowest state of oxidation; for example, spathic iron ore in fine powder, boiled in a solution of chlorhydrate of ammonia, yields a colourless solution, which gives, with ferrocyanide of potassium, a white precipitate. Carbonate of zinc is soluble in all ammoniacal salts, excepting the sulphydrate, which does not dissolve this carbonate even in the presence of free ammonia or carbonate of ammonia; this character enables zinc to be detected and separated from the earths. The separation of zinc from magnesia and manganese can only be effected when phosphate of ammonia and free ammonia are present. Carbonate of lead is easily decomposed by ammoniacal salts; chlorhydrate of ammonia transforms it into chloride, which crystallises out upon cooling. Lead can be separated in this way from the earths, and from magnesia by sulphydrate of ammonia; it is separated from manganese, iron, zinc, and copper by sulphate of ammonia. The green carbonate of copper, *malachite*, and the blue carbonate, *azurite*, are dissolved by solutions of ammoniacal salts, equally in the presence of free ammonia or carbonate; azurite is attacked more rapidly than malachite.

The action of ammoniacal salts on natural carbonates may be summed up as follows:—All ammoniacal salts in solution decompose the natural carbonates, by reason of the volatility of the carbonate of ammonia, which is produced by double decomposition; the acid of the ammoniacal salt unites itself to the base of the carbonate, even when this acid forms with the base an insoluble compound. From the foregoing, one sees that by treating the natural carbonates in fine powder with warm solutions of ammoniacal salts, chosen and mixed so that the acids can form, with the bases of the carbonates, soluble and insoluble compounds, these bases may be separated, and an analysis of the natural carbonates be made. M. Terreil promises in a future communication to treat of the analysis of oxides, sulphides, arsenides, and silicates by neutral saline solutions.

M. Buchner has published some facts in connection with the detection of arsenic in cases of poisoning. M. Buchner has several times recognised the presence of sulphide of arsenic in the bodies of persons poisoned by arsenious acid. Certainly this fact has never been observed except where the corpse has been in a more or less advanced state of putrefaction; the sulphurisation would appear to be due to sulphuretted hydrogen, a constant product of putrefactive decomposition. The last observation upon this point M. Buchner has made, was upon the remains of a woman who had been poisoned eleven months previously; the large intestine was in full decomposition, and there were yellow marks upon the mucous membrane, caused by a fine powder which could be removed by washing. This powder resembled the yellow deposit which is produced in arsenical solutions by sulphuretted hydrogen; further, it gave the characteristic reactions of sulphide of arsenic. Examining now whether the arsenic had been administered as sulphide, he concluded in the negative, for the following reasons:—The contents of the stomach and small intestine being boiled with hydrochloric, and the vapours from the distillation of the acid collected in water, in a few minutes a quantity of chloride of arsenic was obtained; such would not have been the case with sulphide of arsenic, notwithstanding that this sulphide is not absolutely unacted upon by boiling concentrated hydrochloric acid. The sulphide of arsenic being insoluble in pure water and in acidulated water, it would not be carried into the circulation, also it would not be found in the liver and spleen, both of which in this particular case were saturated with arsenic. A part of the stomach and small intestine cut up and placed in the dialyser with water acidulated with hydrochloric acid, gave at the end of twenty-four hours a solution containing arsenious acid in sensible proportion, a fact proving that all the arsenic had not passed into the state of sulphide.

The following memoirs were communicated to the Academy on the 6th inst. "Researches on the combinations of molybdic acid and phosphoric acid," by M.

Debray; "Note on the manner in which sulphuric acid and iodide of potassium act when in contact," by M. Houzeau.

M. Durand read a memoir having for its title, "On the mode of development of heat and cold from a physical point of view;" this memoir was sent to the physical section.

M. Armand submitted to the Academy a new bank paper which he considered inimitable; it was sent to the chemical section. M. Debray's memoir was one of great interest, the translation has already been published in your columns.

All chemists know that iodide of potassium is immediately decomposed with liberation of iodine by ordinary sulphuric acid, but M. Houzeau has shown that an extreme degree of dilution paralyses the chemical affinities to such an extent that the dilute solutions may be boiled together without any change occurring either in the iodide or acid. It was not therefore without surprise, M. Houzeau says, that he read in a recent number of the *Comptes Rendus* a note on the pretended reaction which sulphuric acid always exerts, even in the cold, upon iodide of potassium. Even supposing that the author of this note had used extremely dilute solutions, and that he had operated on neutral iodide and on sulphuric acid deprived of nitrous compounds, his result is easily explained. The ether which served to characterise the reaction of the iodide on the acid, is precisely the reagent which should not have been employed, for this it is that provokes the reaction. M. Houzeau remarked that the confusion here between cause and effect was the less inexplicable when M. Schönbein had, several years ago, pointed out ether to be both a producer and a vehicle of oxygenated water. Thus the peroxide of hydrogen which determined the oxidation of the alkali metal of the iodide and set the iodine at liberty, in the disputed experiment was carried by the ether. Far from contradicting the exactitude of his method of determining oxygenated water, this experiment, M. Houzeau says, confirms it, and shows the great degree of sensibility of the iodide for traces of oxygenated water. He was perfectly acquainted with this perturbing cause, and to avoid it he proposed the employment of pure chloroform, which besides being more sensitive to colouration by iodine, never provokes the mutual reaction of iodide of potassium and sulphuric acid. In conclusion, M. Houzeau maintains the fact to be incontestable, that a mixture of neutral iodide of potassium and pure sulphuric acid remains unaltered in sufficiently dilute solution, and in the conditions indicated in his works on ozone and oxygenated water.

M. Brouzet addressed a note referring to a process for separating good silk-worms' eggs from bad ones. The process consists in treating first with nitrate of silver, and then submitting the eggs to a kind of sorting, by means of their very different densities in water.

CORRESPONDENCE.

PUTRESCIBLE MATTER IN WATER; SANITARY WATER TESTS.

To the Editor of the Chemical News.

Sir,—I have on my premises two supplies of water, namely, one from the Southwark Waterworks, the other from a surface well. The pipe water, when shaken in a wide-mouthed bottle, partially filled, has no appreciably unpleasant smell. When the bottle containing it is set aside in a warm place for three days and then shaken, the contents give out a very faint offensive odour, which is a proof that organic matter held in solution by it has become putrescent. When the freshly drawn pipe water is slightly tinged with a permanganate solution, it gradually loses the colour imparted by that substance, which generally is an indication that it contains organic matter in a non-putrescent condition. Being treated with a further quantity of permanganate and allowed to stand for twenty-four hours, this water, when then set aside in a warm place for three days, is found to be no longer capable of undergoing putrescence. On being shaken up in the bottle it now possesses not the slightest trace of offensive odour.

The well water, when shaken in a partially filled, wide-mouthed bottle, is also free from any appreciably offensive smell. When the bottle containing it is set aside in a warm place for three days, the contents give out a strong odour of putrescence. In this condition it decolourises permanganate rapidly, and in considerable quantities.

The freshly drawn well-water, on being treated with permanganate, decomposes that substance with rapidity, showing that it may be considered to be largely polluted with organic matter of a putrescible nature. When permanganate is added until permanence of colour is obtained, and the water at the end of four-and-twenty hours is allowed to stand sufficiently long to cause the disappearance of the colour produced by the testing solution, it is found to be no longer susceptible of undergoing putrescence. On being now shaken up in the bottle the well-water possesses quite as little trace of offensive odour as the pipe-water after treatment by permanganate. After treatment with the testing solution, neither the pipe-water nor the well-water is capable of decolourising permanganate except by prolonged contact: the less stable organic matters contained in them having been burnt up. These experiments show that both of the above methods of testing exhibit the presence in water of putrescible organic matter—the one, after a considerable lapse of time, to the nose, the other, immediately, to the eye. If it were necessary to choose between the two, several considerations, such as those alluded to by Mr. Muter, would seem to incline the choice in favour of the latter as a popular water test. But so far from this being necessary, these two methods will be found in practice to supplement each other most usefully, and when employed together to furnish results which are sufficiently exact for most sanitary purposes, and as regards the detection of putrescible matter perhaps more to be relied on than some of the refined analytical processes of modern chemistry.—I am, &c.,

H. B. Condy.

Battersea, April 21, 1868.

SCIENCE TEACHING.

To the Editor of the Chemical News.

Sir,—Some months ago you published the conclusion to lectures on chemistry delivered at Eton College, and again in No. 435 you publish the conclusion to lectures on "Heat" delivered in the same place.

If we may judge of the lectures themselves from these extracts, I would say that such lectures are not adapted to attract boys to science. I think that most of your readers will agree with me here.

At the present time, when science is so much talked about as an item of school education, I feel constrained to enter my humble protest against a system of teaching it in high places, which I consider to be calculated to bring it into disfavour.

The current of modern thought tends to the popularisation of science, and the teacher who envelopes science in too learned language is looking back towards the Sodom of the middle ages,—I am, &c.,

D.

DR. GUTHRIE'S GRAPHIC FORMULÆ.

To the Editor of the Chemical News.

Sir,—I conceive the following objections may be urged against the adoption of Professor Guthrie's system of Graphic Formulæ:—

The dot (for hydrogen) is already engaged in Berzelius' scheme to represent oxygen. Guthrie's symbol for oxygen, a horizontal dash, might be easily mistaken for the algebraical sign of minus; the cross, bromine, for the sign of multiplication; the dash and two dots, representing water, are exactly like the sign of division; and the commas for fluorine are likely to be confounded with the double dash now used to indicate the diatomicity of an element. The distinction made between nitrogen and iodine is only a variation in the size of the triangle; and the modified form of the larger triangle (with lines curved inwards instead of straight), intended to represent phosphorus, would often be confounded with nitrogen in roughly executed manuscript; and the same remark applies to the proposed distinction between sulphur and selenium.

Again, the scheme is incomplete, for we ought at least to have been supplied with symbols to represent arsenic, antimony, boron, and silicon, even if the author had not yet decided upon the proper course to be taken with the remaining metallic elements. Much might also be said on the score of want of originality, for the early chemical and alchemic works teem with graphic illustrations and codes of symbols, based upon the same general principle; thus in "Nicholson's Dictionary of Chemistry," dated 1795, there are at the end of the second volume two large folio plates showing "the characters to be made use of in chemistry," as proposed by Haffenfratz and Adet; and "Table vii.—The chemical signs as they occur in the writings of Bergman." Curiously enough, the first of these authorities adopted the horizontal dash as the symbol for oxygen; they used triangles, circles, and squares in every conceivable manner, and actually provided a series of "characters to express such new and simple substances as may hereafter be discovered."—I am, &c.,

F. C. S.

April 18th, 1868.

OZONE.

To the Editor of the Chemical News.

Sir,—The following are the more salient points in the development of ozone during the first three months of the present year:—

January 1st to morn. of 12th. Small amounts, except on the nights of the 3rd and 6th, when there was a tendency to an increasing development. Aft. of 12th—22nd, period with large amounts during the nights (9.30 p.m.—9.30 a.m.) and small amounts during the days (9.30 a.m.—9.30 p.m.) The maximum was found on the night of 18th, and large amounts on the nights of 13th, 14th, 17th, and 19th; 23rd—29th small amounts, except on aft. of 24th when a large amount was present, and on aft. of 27th when there was a tendency to an increasing development. No ozone on 23rd, aft. of 26th, and morn. of 27th. 30th—Feb. 3rd, large amounts. 3rd—16th, a variable period: the periods of increased and decreased development were short and unsettled. Large amounts on 5th and 7th, and on the nights of the 8th and 15th. No ozone aft. of 8th, morn. of 9th, throughout the 12th, morn. of 13th, aft. of 15th, and morn. of 16th. 17th—23rd, large amounts, especially during the nights.

23rd—28th, small amounts. No ozone on aft. of 23rd to 28th—March 17th, large amounts, except on aft. of 2nd, when no ozone was found, and throughout the 3rd when about the average quantity was present. From the 4th—14th there was a very well marked and settled period of ozone. 18th—morn. of 22nd, small amounts; aft. of 22nd—morn of 23rd, large amounts; aft. of 23rd—25th, small amounts. No ozone aft. of 24th and morn. of 25th. Night of 26th; large amounts, aft. of 26th—31st, a variable period with no ozone on aft. of 28th, throughout the 29th and on the morn. of 30th. and considerable amounts on afts. of 30th and 31st. Speaking generally, from the 18th—31st the development of ozone was variable.

The ozone period from the 4th—14th of March was very well marked: it occurred towards the close of a long period of equatorial wind, which shortly afterwards passed into the polar current.

During the whole of the three months the amount of ozone developed during the night (9.30. p.m.—9.30., a.m.) very considerably exceeded that developed during the day (9.30. a.m.—9.30. p.m) This excess in the amount developed by night over that developed by day was greatest in January and least in March.—I am, &c.,

R. C. C. Lippincott.

Eastbourne, April 4, 1868.

MISCELLANEOUS.

Poisoning with Oxalic Acid.—The case of poisoning at Bristol, here recorded, is remarkable in many respects:—

1st. The patient took ¾ of an ounce avoirdupois.

2nd. She died ten minutes afterwards, or very shortly after.

3rd. She vomited almost all the poisoning material, as the coats of the stomach retained by absorption only 2 gr. of the oxalic acid.

4th. There was nothing to be found in the contents of the stomach, which were merely effused blood. The stomach was intensely red, inflamed in that short period.

5th. She tested the contents of her own stomach by having vomited into a bucket of water holding a great quantity of lime in solution. "The vomited matter was like milk," when seen on the floor; and when she vomited into the bucket "it appeared to turn the water into milk."

This did not come out in the evidence, as the girl vomited into the pail in which they were in the habit of washing the glasses and cups used in the bar, and of course the landlord did not want to damage his business by giving such evidence.

The floor was wooden, not of stone, and the oxalic acid was dissolved in hot water, highly charged with lime; and it acted as an instantaneous emetic, and came up almost as it was swallowed, a milky-looking fluid, capable of precipitating a large quantity of lime. At the inquest, the following evidence was taken:—

William James Pester deposed: The deceased, Sarah Salmon, was in my employ as barmaid and housekeeper for nearly twelve months. On Saturday evening she died. I saw her at 20 minutes to seven o'clock, and she then appeared to be quite well. Shortly afterwards she became very sick, and continued so until her death. I went out shortly after half-past six o'clock, and came back about seven o'clock, and I then found her very sick, but still sensible. I asked what was the matter with her, but she did not reply. She was assisted upstairs by the servant, and lay down on the bed. She died shortly afterwards, within ten minutes of her going upstairs.

I sent her up a glass of brandy and water. I sent for Mr. Fardon, and afterwards for Dr. Herapath. She seemed rather peculiar and excited during the wholeo Saturday, especially in the afternoon. Her conduct was very different to her ordinary demeanour, and attracted my attention, she being generally very reserved in her manner. She scarcely spoke half a dozen words to me during the day, and then only when I asked her a question. She stood in the bar leaning against the counter during the afternoon with her arms folded. She would not wait upon the parlour customers, and she would not move out of the way when I wished to enter the bar until I asked her to do so. No one saw her take anything.

Emma Thomas stated: I am in the service of Mr. Pester as general servant. On Saturday, about 7 o'clock in the evening, I noticed that she was very sick in the bar. I helped her upstairs, and she lay on the bed, the sickness still continuing. She died in about 10 or 15 minutes after I got her upstairs. When I first saw her there was a half-pint cup turned upside down in a tray in the bar. It had been recently washed in cold water. No one else could have washed it but the deceased.

Dr. Herapath asked if there was anything peculiar in the vomited matter. Mr. Pester stated that it presented a white, milky appearance—just like lime water.

William Brass: About half-past six o'clock I met Mr. Pester's servant, Emma Thomas, in Castle Street. She asked me if I would get three-pennyworth of oxalic acid for her at the druggist's shop. I complied with her request. I gave it to the girl Thomas, and she delivered it, in my presence, to Miss Salmon.

Dr. Herapath, F.R.S.: I was called in to the deceased a little after seven o'clock. I arrived about half-past seven o'clock, and she was then dead, and had been dead some fifteen minutes. I was told that she had been vomiting, and vomited matter was shown me. The vomit was a very remarkable one—mucus, with curdled, dark stuff—which led me to suspect altered blood. There did not appear to be any particles of food in the vomit. I have since examined the vomit, and I have found oxalic acid in small quantities in it. I have obtained crystals from the vomit, so small, however, that it required the microscope to discover them. I have examined the stomach. It presented an intensely blood-red appearance, and the fluid contained in it was blackened, curdled, altered blood. There were some very small white patches existing on the stomach, and the vessels were braced out and darkened as if by hardened blood. The blood was so altered in character that it was in fact insoluble. If the oxalic acid had been taken in water strongly impregnated with lime salts the white appearance presented by the vomit would be accounted for, as the lime would be precipitated as oxalate of lime. I have never seen an instance of poisoning by oxalic acid before, but I have experimented upon animals. It is a very rapid case of poisoning—one of the most rapid on record. I have no doubt that she was poisoned by oxalic acid. The deep colour of the stomach was caused by the intense irritation, and next by the exudation of blood. The precipitation, darkening, and curdling of the blood are the first symptoms produced by this poison. One-sixth of the quantity taken in this case is recorded as having killed a person, and the shortest time on record is eight minutes. The time in this case I should think was about 15 or 20 minutes.

Mr. Pester: No, I don't think it was so long as that; not more than ten minutes. Mr. Pester also stated that the water drawn from his well and used in his house contained lime in large quantities.

Dr. Herapath: I have not analysed the contents of the stomach. She died unquestionably from collapse, which would be produced by oxalic acid.

Dr. Herapath remarked that the deceased, in his opinion, suffered from impulsive insanity.

The jury returned a verdict of "Temporary insanity."

Discovery of a Silver Lode.—A lode has been discovered on the banks of the Don, in Tasmania, yielding cobalt, silver, copper, and antimony; an analysis, giving the result was of cobalt, 4 oz. to the ton silver, 100 oz. to the ton; and copper, 14 per cent.—*Express.*

CONTEMPORARY SCIENTIFIC PRESS.

Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Comptes Rendus.
December 30, 1867.

F. Pisani, "On Woodwardite from Cornwall." E. Bourgoin, "On the Electrolysis of Tartaric Acid."

Poggendorff's *Annalen der Physik.*
December, 1867.

R. Weber, "On some Compounds of Bichloride of Titanium."

Journal für Praktische Chemie.
December, 1867.

E. Salkoski, "On the Estimation of Hippuric Acid as Hippurate of Iron." H. Laspeyres, "On the Composition of Prehnite." T. S. Hunt, "On J. D. Whelpley and J. J. Storer's New Method of Treating Ores." J. H. Gladstone, "On Pyrophosphoric Acid." H. Ritthausen, "On the Use of a Solution of Sulphate of Copper and Potash as a Test for Protein Compounds." C. Bigott and R. Fittig, "On the Synthesis of some New Hydrocarbons."

Annales de Chimie et de Physique.
December, 1867.

Boussingault, "On the Decomposition of certain Sulphates at a High Temperature."

Le Technologiste.
October, 1867.

E. Beanes, "On the Use of Ozone for Whitening Sugar, Syrup and Molasses."

Comptes Rendus.
January 6, 1868.

A. Houzeau, "On the Estimation of Minute Quantities of Peroxide of Hydrogen." H. Gal, "On the Action of Chloride of Cyanogen on Zinc-Ethyl."

January 13, 1868.

A. Rommier, "On Xylindeine, a New Colouring Matter Extracted from Decayed Wood."

January 20, 1868.

A. W. Hofmann, "On the Compounds Isomeric with the Sulphocyanic Ethers; 1. Oil of Mustard of the Ethylic Series."

Monatsbericht der Koniglich Preussischen Akademie der Wissenschaften zu Berlin.
September and October, 1867.

Hofmann, "On a new Series of Isomers of the Nitriles." "Contributions to the Knowledge of Methyl-aldehyde."

Poggendorff's *Annalen der Physik.*
December, 1867.

C. Rammelsberg, "On the Phosphites."

Annalen der Chemie und Pharmacie.
December, 1867.

F. Beilstein, "On Xylol and its Derivatives." H. Y. de Schepper, "On Sulphydrate of Xylil (Sulphoxenol)." A. Vollrath, "On Chloride of Xylol, Chloride of Tolyl, and their Derivatives." W. Holleman, "On Dichloride of Xylol and Trichloride of Xylol." F. Beilstein, "On Nitroxylol and its Derivatives." G. Deumelandt, "On Xylidine and its Derivatives." E. Luhmann, "On Dinitroxylol and Trinitroxylol." R. Fittig and J. Konig, "On Ethylbenzol and Diethylbenzol." G. Stadeler, "On the Constitution of Phenyl-sulphuric Acid." H. Limpricht, "On the Amines of Benzyl Alcohol." H. Wichelhaus, "On the Constitution of Organic Acids containing Three Atoms of Carbon."

January, 1868.

A. Grabowski, "On the Tannic Acid of Oak Bark." R. Otto and O. von Gauber, "On Toluol-Sulphurous Acid." "On the Estimation of Sulphur in Organic Substances by means of Chromate of Copper." R. Otto, "On Bichlorsulphobenzide." E. Linnemann, "On the Preparation of the Fatty Alcohols from their Primary Members." "On Artificial Methyl Alcohol." A. Siersch, "On the Preparation of the Fatty Alcohols from their Primary Members." "On the Transformation of Methyl Alcohol into Ethyl Alcohol." W. Heintz, "On the most Simple Process for Preparing Glycolamidic Acids from Monochloracetic Acid." L. Scheffer, "On Obtaining a Double Phosphate of Zinc and Soda by Fusion." A. von Flemming, "Note on Sulphochloride of Phosphorus." H. Schweikert, "Note on Phosphate of Soda and Ammonia, and on the Separation of Phosphoric Acid from Oxide of Zinc." K. Birnbaum, "On the Combinations of Ethylene and its Homologues with Bichloride of Platinum." A. Geibel and H. L. Buff, "On a Hydrocarbon analogous to Ethylene, obtained from Chloride of Hexylidene."

Annales des Mines.
1867.

W. Eggertz, "Note on the Estimation of Sulphur in Iron and Iron Ores."

Comptes Rendus.
January 27, 1868.

J. Reiset, "Chemical Researches on the Respiration of Cattle." (Continuation.) "On the Influence of Food on the Respiration of Cattle." "A Comparative Study of the Respiration of Calves fed on Milk, and Calves at Grass." "On the Nature of the Gases of the Hoove in Cattle, and on a Remedy for the same." "Note on the Production of Nitric Oxide during the Fermentation of Beet Juice." "On the Estimation of Ammonia in Beet Juice." L. Marignac, "On the Reduction of Niobium and Tantalum Compounds." H. Deville, "On the Extraction of Niobium." H. Debray, "Researches on Dissociation."

February 3, 1868.

T. Schlœsing, "On the Decomposition of Nitrates during Fermentation."

February 10, 1868.

E. Becquerel, "Fourth Memoir on some newly discovered Electro-Chemical Effects of Capillary Action." Dubrunfaut, "Memoir on a Nitrogenous Substance possessing greater Activity than Diastase contained in Malt, and on the Preparation and Application of the same in Manufactures" "On the Distillation of Beetroot, and on the Formation of Nitric Oxide during the Fermentation of the same." A. Chauveau, "On the Nature of Vaccine Virus.—Experimental Determination of the Elements which constitute the Active Principle of the Virus of Small Pox."

Annalen der Chemie und Pharmacie.

Supplement.

J. Von Liebig, "On some Methods of Silvering Glass." W. von Schneider, "A Method of Obtaining Pure Platinum and Iridium." H. Kopp, "On the Boiling Points of the Hydrocarbons." H. Schiff, "On Aldehyde Bases." E. Erlenmeyer, "On the relative Constitution of the Butylic and Amylic Alcohol of Fermentation."

Bulletin de la Société Chimique de Paris.

December, 1867.

Berthelot, "On a new Thermometer for Measuring High Temperatures." A. Scheurer-Kestner, "On a Crystallised Stannate of Sodium." Berthelot, "On Alcoholate of Baryta." "On the Oxidation of Organic Acids." J. B. Grange, "On the Quantity of Urea contained in the Urine of Persons Suffering from Chlorosis." Gondolo, "A Modification of Boussingault's Process for Manufacturing Oxygen and Nitrogen by passing a Current of Atmospheric Air over Caustic Baryta." Bothe, "On Tessié du Mothay and O. Maréchal's Process for the Manufacture of Oxygen." Jacquemart, "A new Process for the Manufacture of Sulphite of Alumina." A. Girard, "A Process for the Manufacture of White Lead." Juette and de Ponteves, "A Process for the Manufacture of Tartaric Acid from Refuse Grape Skins." Dusart, "A Method of Preparing Essence of Bitter Almonds for Use in Perfumery." P. Schutzenberger, "A Method of Remaking Waste Paper." Perier, Possoz, Cail, and Co., "An Improved Method of Using Lime for the Preservation of Saccharine

NOTES AND QUERIES.

Extract of Madder.—Can any of your readers inform me how the extract of madder which is now being used, is made.—W. B.

Estimation of the Sulphur Acids.—Can any reader suggest a method by which NaS, NaO,SO_2 and NaO,S_2O_2, can be detected and estimated separately in ordinary commercial "soda-ash."—W. Blackril.

Unit of Momentum.—I will be much obliged if any one will inform me what the value of the unit of "momentum" is in avoirdupois weight. Our books on Mechanics tell us that momentum, or "quantity of motion," is equal to the product of the quantity of matter into the velocity, thus, $M = QV$. Now, suppose 1 lb. of matter moves 1 foot per sec., what is its moving force or "momentum" in avoirdupois ounces?—J. R. B., Davidson College, N.C.

Information Wanted.—A correspondent at Halifax, Nova Scotia, wishes to be put in communication with parties who would give reliable information—1. On the best ways of utilising the waste in iron-works, arising from the operations of planing, turning, boring, &c. 2. On the best way of manufacturing chloride of lime. 3. On the best way of manufacturing paper pulp from wood.

Palm Oil for Softening Dyed Yarns.—Palm oil and other oils may be made to mix with water without the use of alkalies, by subjugating, or incorporating with the oil albuminous substances, best yolk of eggs, along with a small quantity of glycerine, and sometimes a solution of gum may be useful; in this way a magma is obtained which may be gradually mixed with water, and will form what is called an emulsion, in fact a mixture of water and oil, or better and more correctly, oil minutely divided through water by the aid of albumen. It is a well known fact that the yolk of eggs contains a large quantity of oil in its natural state, to which its colour is due, and which oil undoubtedly also assists the forming of an emulsion.—Dr. A. A.

Estimation of Chlorine.—Mr. Dunn will undoubtedly find in the manifold published works on Analytical Chemistry, Guy Lussac's method, as also those of Mohr and Wagner, and perhaps he may try if he likes Runge's method, which is not so generally known, and is executed in the following manner:—Two grammes of the bleaching powder to be tested are well mixed with water, and the fluid so obtained mixed with a solution of protochloride of iron freshly made by dissolving 0·6 grm. of pure iron wire in pure hydrochloric acid, next pure hydrochloric acid in excess is added, and the fluid boiled in a flask, after previous addition of a piece of rather thick, perfectly clean, and brightly polished sheet copper, of a weight of about 4 grammes: the boiling is continued until the at first darkish colour of the fluid has become bright green; the copper is then removed from the flask, washed with distilled water, dried, and weighed. A loss in the weight of copper of 63·4 = 2Cu, is equal to 35·5 chlorine in the bleaching powder. This method is based on the fact, that under the conditions described, the chlorine of the bleaching powder first changes the protochloride of iron into perchloride, which in its turn is again reduced to protochloride by the metallic copper, whereby some of the latter becomes dissolved; for every 2 equivalents of copper dissolved in this way there is 1 equivalent of chlorine in the bleaching powder.—Dr. A. A.

MEETINGS FOR THE WEEK.

Monday.—Royal Geographical, 8½.
— Medical, 8.
— Philosophical Club. Anniversary Meeting, 6.
Tuesday.—Royal Institution, Dr. M. Foster, "On the Development of Animals," 3.
Wednesday.—Society of Arts, 8.
— London Institution. Anniversary Meeting, 12.
Thursday.—Royal, 8½.
— Royal Institution. Professor Odling, "On Chemical Combination," 3.
— Zoological. Anniversary Meeting, 1.
— Royal Society Club, 6.
Friday.—Royal Institution, 2. Annual Meeting. F. T. Palgrave, Esq., "How to form Good Taste in Art," 8.
Saturday.—Royal Institution. Professor Odling, "On Chemical Combination," 3.

Patent Gas Producing Mixture.—It having come to the Subscribers' knowledge that some individuals in Britain have exported to Paris, and other Continental towns, quantities of a Gas-producing Mixture, known in Britain as "M'Kenzie's or Hamilton's Patent," the Subscriber, Mr. B. Hugo Dullens, who holds Patents for this invention for France, Belgium, Holland, Italy, Austria, Denmark, and other Continental Countries, as well as the United States, hereby warns all parties against exporting any of said Patented Material, certifying those who shall do so, that not only will the Material be confiscated, but he will proceed against them for such penalties and damages as the Law may award to him.
B. HUGO DULLENS, Bieberich, Nassau.
JAMES Y. PULLAR, I.S.C,
17, Broughton Place, Edinburgh,
Agent for Mr. Dullens.

Pharmaceutical Society of Great Britain.—SCHOOL of PHARMACY.—SESSION from OCTOBER to JULY.

LECTURES.—On Chemistry and Pharmacy, by Professor Redwood. On Botany and Materia Medica, by Professor Bentley.

LABORATORY for Practical Instruction in General and Pharmaceutical Chemistry.—Director, Dr. Attfield; Assistant, Mr. Tilden.

A syllabus of Instruction and particulars of the Examinations may be obtained from the Secretary, 17, Bloomsbury Square, W.C.

The Scientific Wonder.—This Instrument has a clear magnifying power of 32,000 times, shows all kinds of Animalculæ in water, Circulation of the Blood, &c., &c., Adulteration of Food, Milk, &c., and is just the microscope that every Surgeon, Dentist, Schoolmaster, Student, and Working Man should have. It is pronounced by the Press (and all scientific men who have seen it) to be the best, cheapest, and most simple Microscope ever invented. It has twenty times the power of the Coddington or Stanhope Microscope, and is twice as good as the celebrated Rae Microscope (which has been awarded so many prize medals), as may be inferred from the following letter, received from Mr. Rae himself:—

Carlisle, December 12th, 1867.
To Mr. McCulloch, Philosophical Instrument Maker.
Sir,—Having seen some of your Diamond-Plate Lenses, I write to ask your terms for supplying me with the same per 20 gross, as I consider them superior to mine.—Yours, &c.,
RAE & Co., Opticians, Carlisle.

I beg to inform the Public that I have no Agents anywhere, and all pretended Agents are Impostors. The above Instrument can only be had from me, in Birmingham. Those at a distance who care for instruction and amusement, can have it safe and free by sample post, with book of full instructions, on receipt of 32 Postage Stamps.

All persons wishing further particulars and testimonials, must send stamped and addressed envelope.

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MEDAL PARIS EXHIBITION, 1867.

Methylated Spirits.—David Smith Kidd, Licensed Maker, Commercial Street, Shoreditch, N.E. Also, FINISH, FUSEL OIL, and RECT. NAPHTHA.

THE CHEMICAL NEWS.

Vol. XVII. No. 439.

ON THE ESTIMATION OF SULPHUR IN IRON AND ITS MINERALS.*

By M. W. EGGERTZ,
Professor at the Fahlun Mining School.

As small quantities of sulphur, even a few ten-thousandths, are sufficient to render iron, even of excellent quality, red-short and unfit for certain uses, it would be very useful to be able to ascertain the quantity of sulphur which exists in the iron, not only with the necessary scientific exactness but also with a facility and accuracy suitable for practical wants. But as the methods ordinarily employed for this purpose, especially on the score of facility, leave much to be desired, I have been engaged for several years in improving the known processes, and I wish to communicate in these pages the results of my researches. I have found in this difficult work, especially in the estimation of sulphur in iron analytically, useful aid on the part of M. J. E. Sieurin, and some other students of the Mining School, but I must especially mention the valuable services of M. J. F. Lundberg.

A. *Detection of sulphur by means of chloride of barium.*

1. Iron.—5 grammes of iron passed through a sieve with apertures of 0·6 m.m., are added to a solution of 10 grammes of pure chlorate of potash, free from sulphate, in 200 cubic centimetres of distilled water, and contained in a flask of a capacity of 500 c.c. Cover this flask with a small funnel and heat the contents on a sand-bath to complete ebullition; then add gradually 60 c.c. of hydrochloric acid of the specific gravity 1·12.

It is best to add the hydrochloric acid at first drop by drop from a burette, as otherwise a strong disengagement of gas would take place; but in proportion as this evolution diminishes larger quantities of acid may be added; ordinarily half an hour is required for this operation, and during this time the solution ought to be kept in complete ebullition, so that no sulphuretted hydrogen gas escapes. Then allow the liquid to boil gently for five or six minutes more. In this way the carbon and part of the silicic acid remain insoluble, and often also a brown flocculent or pulverulent substance resembling hydrated oxide of iron, which is composed of a geic product analogous to humus, which is formed from the carbide of iron. During the solution a little sulphur is also sometimes separated; it swims on the surface. To oxidise this sulphur and drive off the chlorine and hydrochloric acid which are present in the solution, it must be evaporated to dryness in a water-bath; the sides of the flask and the small funnel which covers it should always be first well washed with a jet of distilled water.

If there is much sulphur on the surface the moment it has disappeared the funnel should be replaced by a paper cover. When the solution has become syrupy the desiccation should be hastened by stirring it well with a glass rod. Add to the dry mass 10 c.c. of hydrochloric acid and 30 c.c. of water, and then leave the mixture on the water-bath until all the crystals of chloride of iron are dissolved, then add about 20 c.c. more water, and collect the insoluble portion on a filter, washing it perfectly with warm water. It sometimes happens that during the washing the organic matters remaining on the filter dissolve and precipitate again in contact with the acid solution, but they are easily redissolved on boiling the liquid. The last washing water ought to have no acid reaction; evaporated and heated to redness on platinum foil it should leave no trace of residue.

The filtered liquid, whose volume is about 50 c.c., should be rapidly boiled and mixed with 2 c.c. of a saturated solution of chloride of barium. (This amount is sufficient to precipitate the sulphuric acid formed from 0·1 grm. of sulphur). After cooling add to the mixture 5 c.c. of ammonia sp. gr. 0·95, then stir well with a glass rod, and leave the whole to rest at the ordinary temperature for twenty-four hours. The clear solution should be decanted as completely as possible on to a strong filter, and the precipitate stirred up with about 20 c.c. of cold water, and then left to itself until it has quite settled. If warm water is used without having added a few drops of hydrochloric acid, a little oxide of iron will precipitate. The clear liquid is likewise thrown on to the filter, and the operation is repeated several times with cold water, and then two or three times with boiling water, without which precaution the sulphate of baryta will pass through the filter. Finally collect the precipitate, and wash it carefully with warm water. The last drops of this water on being evaporated on a watch-glass ought not to leave more than a scarcely visible white ring. The precipitate is then dried, heated to redness, and weighed. If it is coloured with oxide of iron it must be washed with a little hydrochloric acid, dried in the water-bath, and taken up with a few drops of acid and water, and then the preceding operations repeated (washing, drying, heating, and weighing). If the precipitate has only a feeble red colour, which is often the case, this latter operation will be unnecessary.

100 parts of sulphate of baryta contain 34·3 parts of sulphuric acid, or 13·72 parts of sulphur. If in this experiment 5 grms. of iron have been used, each 0·001 grm. of sulphate of baryta will correspond to 0·00274 per cent of sulphur in the iron.

ON THE MANUFACTURE OF GLASS.

By HENRY CHANCE, M.A.

Abstract of a Lecture delivered at the Chemical Society, March 19th, 1868.

Referring to the raw materials of which glass is made, the various qualities of sand were in the first place described. The American sand is considered the finest of all; then that from Fontainebleau; Belgian next; and, of English samples tolerably free from iron, the deposits occurring at Leighton Buzzard were in great demand. This quality is, indeed, almost exclusively employed by the Messrs. Chance, and, though of a yellowish tint, contains less iron than many whiter samples. Sand of a strong reddish hue may be made nearly white by calcining it with a small quantity of common salt. The Welsh sand is not held of much account, for it seems to produce glass in which striæ abound.

With respect to the alkaline ingredients for glass making the use of kelp, soda of alicant, and Egyptian natron were briefly noticed, and the influence of Le Blanc's discovery traced. The substitution of the sulphate for the carbonate of soda—due to Gehlen—tended to cheapen the glass, but at the sacrifice of quality; for the best kinds of plate glass the carbonate (soda ash) is always employed. For the common blown window glass the sulphate answers well: it will permit the use of larger charges of lime, and the glass produced from it is harder, takes a better polish, is less liable to devitrification, and to the alteration of its surface by what is termed "sweating." The addition of carbon in the form of charcoal, or powdered anthracite, facilitates the reduction of the sulphate, and tends to promote vitrification. Only one atom of carbon is, in practice, found sufficient for two atoms of sulphate of soda. The object of its employment would, then, seem to consist in furnishing the means of reduction of a part only of the alkaline sulphate to the state of sulphite, and not to sulphide; the decomposition of the sulphate is further facilitated by a liberal use of carbonate of lime, the action of which is not clearly intelligible. Glass made from sulphate of soda is of a bluish, whilst that made from the carbonate is of a yellowish tint. When an extra pale colour is desired, the carbon is kept at a minimum, and the lecturer once saw, at glass works in the north of France, an expedient practised in this direction, which consisted in employing the sulphate in large excess, and ladling off the upper layer of this fused salt whilst the pots stood in the furnace. Should any of this ingredient be accidentally left in the crucible, "salt-blisters" are formed.

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* *Moniteur Scientifique.*

The lime required for the crucible charges is introduced in the form of quick-lime when carbonate of soda glass is made; but for the other kind either chalk or limestone, preference being given to the latter, probably on account of its containing some carbonate of magnesia. This addition of lime is in flint glass replaced by oxide of lead, giving great lustre and refracting power, but if made into sheet would be full of striæ. Pipe clay and alumina are sometimes used in glass making, but are not supposed to improve the quality; all glass fused in clay pots must necessarily contain more or less alumina, and it has been noticed that the outer portions next the crucible often show irregularities, and occasionally some coarse gritty particles become detatched from the inner surface by corrosion of the finer clay under the action of the fused alkali. Chloride of sodium excepted, no appreciable amount of alkali is lost by volatilisation in the furnace; at any rate, the deficiency from all sources of waste, including the mixing, decrepitation on first heating, &c., never exceeds 1 per cent.

The average composition of different qualities of glass was stated to be as follows:—

Crown and Sheet Glass.

	English.	Foreign.
Silica	73	74
Lime	13	14
Soda	13	11
Alumina, oxides of iron, and manganese	1	1
	100	100

Ancient Glass.

	12th century.	16th century.
Silica	51·60	54·60
Alumina	2·16	8·96
Protoxide of iron	1·58	0·75
Lime	8·04	19·31
Magnesia	2·22	3·43
Alkalies	34·40	12·95
	100·00	100·00

The use of peroxide of manganese and arsenious acid in glass making is mainly for the purpose of effecting the peroxidation of the iron which in this state has far less colouring property. The author here pointed out as an anomaly the circumstance of carbon and metallic oxides being employed in the same mixture, but an attempt to defer the addition of the latter until the carbon had done its work was only partially successful, since it is difficult in the last stages to ensure a proper incorporation of the materials. The Belgian manufacturers are said to have discontinued the use of the above metallic oxides. The purest coloured flint glass is composed of sand, potash, and oxide of lead. For some kinds of optical glass a portion of the red lead is replaced by lime, and if the lead is used in excess the heavy flint glass produced has a strong yellowish tint. When much manganese is employed to correct the colour arising from impurities in the glass mixture, there is a tendency for the glass to undergo changes of colour upon exposure to sunlight; and a greenhouse roofed with glass in which manganese has been used will often display, after a lapse of time, a great variety of tints. Reference was then made to Mr. Gaffield's experiments on the action of sunlight upon glass, and to the practical conclusion arrived at, to the effect that the alteration in colour was solely due to the different states of oxidation of the manganese. The lecturer further asserted that he had noticed changes of colour in glass which did not contain a trace of this metallic oxide, and specimens were exhibited in which the glass, originally white, had become strongly tinged with yellow. In connection with the employment of Siemen's regenerating furnaces at his works, Mr. Chance stated the following particulars. The cubical capacity of the glass furnace was about 1800 feet (or 20 feet long, 10 broad, and 9 feet high). This chamber accommodated eight large clay melting-pots, each of which was capable of producing two tons of refined glass in five and twenty hours. The saving on Siemen's plan was, firstly, the difference in cost between large coal and slack; and, secondly, a more cleanly manipulation, whereby a superior product was obtained in open pots. By way of conclusion the lecturer described Gossage's process for the manufacture of soluble glass, and the results of his own experiments on the fusion and devitrification of the basaltic rock known as "Rowley Rag." A large slab of the fused material, which is similar to black marble, and other specimens of the same devitrified, were exhibited.

TEST FOR BROMIDES.

By Surgeon J. H. BILL, U.S. Army.

In conducting some investigations during the past summer, on the physiological relations of the halogens, it became absolutely necessary in the course of the experiments, to devise a ready and sensitive test for bromine in the presence more particularly of chlorine.

Any analyst will bear out the assertion—although the books make light of the matter—that it is a difficult thing to recognise traces of bromine in the presence of excess of the other halogens. Thus in the case stated above, it was found impossible to obtain by the ordinary methods of the books, a certain and easy recognition of bromine when chlorine was present.

The Fresenius test solution of auric chloride produces in faintly acid solutions of alkaline bromides, a colouration ranging from dark orange red to light straw colour, according to the strength of the solution. Iodides must be out of the way. Chlorides, however, do not interfere in the least. The following is the best way of applying the test:—Separate iodides by palladium, and after getting rid of excess of palladium by sulphuretted hydrogen, concentrate the solution to about twenty-five cubic centimetres. Select two test tubes, of the same size and shape, and colour of glass. Into one pour the solution suspected to contain bromide. Into the other pour pure water, adding perhaps a trace of chloride potassium; add now to each test tube a drop of chlorhydric acid, and then to each *one* drop of auric chloride solution. On now comparing the two tubes particularly in the direction of their long axes, a yellow colour will be observed in the tube containing the bromide, and made very manifest by comparison with the other tube.

The following experiment shows the delicacy of the test applied as above:—One centigramme of potassic bromide was dissolved in one thousand cubic centimetres of water. Thirty centimetres of this solution, compared with thirty centimetres of a very weak solution of potassic chloride, gave a decided yellow colour. This experiment was varied by dissolving a gramme of potassic chloride in two thousand cubic centimetres of water, halving, and adding one centigramme of potassic bromide to the one half. Thirty centimetres of each of the two solutions now tested, gave ample evidence of the presence of bromide.

The mixed chloride and bromide should be brought to the state of salts of the alkalies if necessary, by precipitating with argentic nitrate, thoroughly washing, and fusing with potassic carbonate. If sodic carbonate is used, the subsequent reaction with the gold test is not so decided.

A test for chloride in the presence of bromide, as simple and delicate as the above, is much needed. The writer has sought long for it but in vain.—*Am. Journ. Sci., March*, 1868.

ON THE CHEMISTRY OF THE BESSEMER PROCESS.*

Analyses representing each successive step in the Bessemer process do not appear, as yet, to have been published. The following analyses of the raw material and the various products at different stages of this process were sent with the manufactured objects to the late Paris Exhibition from the Bessemer Works of Neuberg, in Austria. In the absence of more complete analyses, they may be of some value.

The charge was a good dark-grey iron, weighing 62 cwts. 80 lbs. (Austrian); it was transferred directly from the blast furnace into the converter. Blast was applied for 28 minutes under a pressure of 20 lbs. to the inch; at the close of this first period a sample of the iron was taken. During the second period, of 7 minutes, the pressure of the blast was 18 to 19 lbs. per square inch; the third period lasted only 3 minutes, under about the same blast. The amount of slag was a little larger than usual, probably because of the taking of samples from the mass. The analyses of the raw-iron and of the samples taken at the close of the above period, gave the following results:

1. The iron taken was dark-grey, graphitic, containing considerable silicon, very little phosphorus and sulphur, and much manganese; in every respect an excellent material for the Bessemer process. A small amount of copper was present, but not enough to either hinder the process or deteriorate the product.

2. At the close of the first period spoken of, all graphite had disappeared, partly by combustion, partly by combination with the iron; almost four-fifths of the silicon had been separated; all but a trace of sulphur had disappeared; the amount of phosphorus remained nearly the same; also the total amount of the copper, while its percentage was a little higher; much of the manganese was lost. The product at the close of this period was a pure white raw-iron, containing not overmuch of carbon.

3. During the second period the removal of the carbon progresses rapidly, so also the still remaining silicon and manganese are rapidly disappearing, while again the copper and phosphorus remain almost the same. The product at the close of this period of only about seven minutes was a good steel; according to the common scale, steel No. 3.

4. At the close of the third period, a steel No. 7 was obtained. The addition of 6 cwts. raw iron gave a Bessemer steel No. 6.

The slags obtained at the various stages were also analysed; they always contained a great relative amount of silica, but, both before and after the second (or "boiling") period, remarkably little of ferrous oxide. During the last stages of the process, the percentage of manganese in the slag decreases, because most of the manganese is removed in the first period, so that the increase of slag during the last stages of the process can only add iron to it, *i.e.*, reduce the percentage of the manganese. A little alumina and lime found in the slag is ascribed to the walls of the furnace.

From the composition of the raw material and the final product, the amount of the various elements removed during the process is obtained by the difference of the first two quantities. The amount of oxygen necessary for this removal may easily be calculated on the supposition that the silicon is converted into silica, carbon into carbonic acid (CO), phosphorus to phosphoric acid (anhydride), sulphur to SO_2 or SO_3; iron to magnetic oxide (Fe_3O_4), of which but a small amount is found in the slag, the greatest portion being blown out in the shape of a red smoke (Fe_2O_3). The following table contains the results thus obtained:

	Raw iron taken. lbs.	Bessemer steel obtained. lbs.	Removed. lbs.	Requiring Oxygen. lbs.
Carbon ..	258·59	12·79	245·80	327·73
Silicon ..	128·97	1·80	127·17	139·07
Phosphorus	2·63	2·40	0·23	0·29
Sulphur ..	1·13	—	1·13	1·69
Manganese	227·67	7·59	220·08	63·56
Copper ..	5·59	5·59	—	—
Iron (by difference) ..	5956·42	5429·82	525·59	200·22
Total	6580·00	5460·00	1120·00	732·56

	Producing lbs. of	
Carbon	573·53	CO
Silicon	266·24	SiO_2
Phosphorus	0·52	P_2O_5
Sulphur	2·82	SO_3
Manganese	283·64	MnO
Copper	—	
Iron (by difference)	725·81	Fe_3O_4

This amount of oxygen can be had in 43,330 cubic feet of atmospheric air, or 1,140 cubic feet per minute, or 660 cubic feet per cwt. of the charge.

The supposition that the carbon burns to carbonic oxide (CO) and not to carbonic acid (CO_2) seems to be proved by the spectroscopic investigations of Lielegg.

GRAPHITE IN CALIFORNIA.

The principal plumbago deposit of California, known as the Eureka Black Lead Mine, is situated on the west side of Tennessee Gulch, a tributary of Wood's Creek, about 1½ miles from Senora, the county seat of Tuolmune county, and about 68 miles from Stockton, the head of navigation on the San Joaquin River. The mineral exists as a well-defined lode, from 20 to 30 ft. wide, having a dioritic foot-wall on the west, and a soft clay-slate hanging wall on the east. The trend of this lode is nearly north-east by south-west, and it dips very irregularly to the east, at some places being nearly vertical, and at others nearly horizontal. It has been traced and explored for 3,900 ft., beyond which there are but faint indications of its existence. The whole deposit, including the walls and vein, is enclosed in the limestones peculiar to Tuolmune and the adjoining counties.

The graphite near the surface is much contaminated with the materials of the clay-slate, which rapidly decomposes on exposure to the atmosphere. It was this circumstance that delayed the development of the mine, as it was found impossible to separate the earthy matter from the more valuable plumbago. About two years since it was discovered that the graphite floated on water, when a simple apparatus was employed, which separates nearly 100 tons per day, giving employment to some 25 labourers to wheel the stuff from the mine to the arrastre, about 50 ft. distant. This separating process is not now required for in a large portion of the vein below the surface, at a depth of 40 ft., the graphite is cut out in solid blocks, and sacked without any further preparation; but it is divided by lenticular bodies of clay-slate, a few inches thick, and sometimes extended for several feet. This material is heavily charged with graphite, and is washed in order to separate it. At the depth of 60 ft. the graphite is exceedingly solid and hard, with a very fine lustre. The whole material is taken out between the walls by an open cutting; all found not absolutely pure is washed, the other is bagged at once.

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* "*Aus der Natur*," 1867, p. 714, &c.

The product of the mine at present is about 1,000 tons per month, but is capable of an almost indefinite extension. The process of separating the graphite from the impurities is very simple. An inexpensive sort of large vat, with a stone bottom, 20 ft. in diameter, and 3 ft. deep, holds the materials, which are stirred up by iron rakes, fastened to four cross-bars projecting from an upright shaft, moved by a water-wheel. When in motion a small stream of water passes into this vat, an outlet to which exists a few inches from the surface; through this outlet the graphite passes with the water, and is led by spouts into broad tanks, where it temporarily subsides, when the dirty water is run off, and a large stream of clean water forces the graphite into a series of shallow tanks, in which it is dried by the sun, the whole process requiring about five days to complete. The tanks and reservoirs at present used cover several acres. The cost of production of the solid plumbago at the mine does not exceed 4s. per ton, two men in the lower workings being able to extract 10 tons per day of solid graphite, in blocks of any desired size. The water used on the mine costs but £10 per month, which sum is more than realised by gold found in the vat when cleaning up, there being a thin seam of auriferous quartz between the hanging wall and the graphite occasionally passing into it. Lumps of gold, worth from 8s. to £4 each, are sometimes found imbedded in the graphite.—*Dicker's Mining Record.*

ON THE
EMPLOYMENT OF SAND AND GLASS FILTERS IN QUANTITATIVE ANALYSIS.

By WOLCOTT GIBBS, M.D.,
Rumford Professor in Harvard University.

Sufficient attention has not been paid to the advantages of filters of sand and glass over those of paper, when precipitates are to be dried upon the filter at a definite temperature. By choking the throat of a funnel with coarse fragments of glass and then placing upon these successive layers of powdered glass or sand, the upper layer being of the finest powder, it is easy to make a filter upon which almost any precipitate may be filtered off and washed out completely without the slightest loss. The funnel with its contents may then be dried at any temperature below that at which the glass softens or at which the precipitate undergoes chemical or physical change. Mr. E. R. Taylor, who has carried out this suggestion with the greatest care and thoroughness, obtained the following results in three analyses of tartar-emetic:—

	Grm. tartar-emetic.		Grm.			
I.	0·0917	gave	0·0463	Sb_2S_3	= 36·09	per cent Sb.
II.	0·6236	"	0·3149	"	= 36·08	"
III.	0·1766	"	0·0891	"	= 36·07	"

The formula requires 35·92 per cent (Sb = 120).

In the first and second analyses the precipitated sulphide was dried at 375°C. In the third, the funnel had the shape of a tube tapering at one end and dilated in the middle to a sort of bulb, and the precipitated sulphide of antimony, after drying, was ignited in the filter tube itself in a current of carbonic acid gas. This form of funnel, which is due to Mr. Taylor, will be found very advantageous. A small common funnel may be inserted into the top, and after drying, the tube funnel closed with a cork in weighing.—*American Journ. Science.*

FOREIGN SCIENCE.

Paris, April 28, 1868.

Tar-water.—Extraction of the colouring matter from madder.—Petroleum in Galicia.—Academy of Sciences.—Formula of molybdic acid and equivalent of molybdenum.—Production of paracyanogen and transformation into cyanogen.

The medicinal properties of tar-water administered externally and internally in the treatment of various diseases of man and other animals are well known. Up to the present time this solution has not been manufactured in such a way as to contain a fixed proportion of tar. M. Guyot de Grandmaison, an intelligent chemist, has succeeded in obtaining a tar liquor perfectly capable of mixing with water, and containing a certain percentage of resinous matter. The application of his concentrated definite tar liquor has been attended with the greatest success, and this new preparation has, according to a report of one of our best practitioners, "*comblé une véritable lacune.*" Several trials were made with this article, in fifteen public hospitals in Paris, with the best results. This is a most natural consequence of the solution of tar, containing in a small volume all the active and medicinal portions of the tar, to the exclusion of the bitter empyreumatic principles always disagreeable to a sick palate, and often injurious to certain affections. No foreign substance is allowed to enter that can alter, suspend, or complicate the expected and precise effects of the medicament. The effects are produced by the tar alone, and by no other ingredient. Starting from the fact that two tablespoonfuls of the liquor, added to a litre of water, constitute a tar-water of average strength, and always constant, it is easy to increase or diminish the intensity at will. Pure, or mixed with water, the concentrated tar essence can be put to a variety of new usages which were not available for want of a convenient method of administration; in fact, ordinary tar-water was so slow in action that it had almost been set aside. A number of uses will at once suggest themselves to medical men; among the uses to which this new liquid is applicable, the following may be mentioned—the treatment of infectious wounds, skin diseases, small-pox, neuralgia, and rheumatism. In the shape of vapour, the tar-liquor has been frequently used with success in cases of pulmonary consumption and bronchitis. M. E. Guyot's address is Rue des Francs Bourgeois, 17; the success of his preparation is well deserved.

A process for the extraction of the colouring matter of madder has been patented by M. Guignot. This process only differs from that patented by M. Leitenberger, in garancine being operated upon instead of madder. In an exhausting apparatus, the garancine is submitted to treatment with boiling water. As soon as the water has passed through the filter, it is replaced by more, until the garancine is completely exhausted. Each quantity of hot water that has passed through is charged with a large proportion of colouring matter, which is nearly pure; by mixing all the coloured filtered liquors, and allowing the solution to cool, and repose a sufficiently long time, the colouring matter, previously kept dissolved by the heat, gradually becomes less ond less soluble, and at last precipitates to the bottom of the vessel. The supernatant liquid, which is almost colourless, is decanted, and the deposit thrown on to calico filters to drain, afterwards being dried sufficiently to enable the colouring matter to be transported in commerce, in the shape of powder. Garancine is obtained by submitting ground madder, exhausted by water of all soluble principles, and again dried, to treatment with concentrated sulphuric acid at a temperature of 100°. The ligneous, glucous, and pectous matters under this treatment become carbonised, while the colouring matter is left intact; washing with a little cold water removes the adhering acid, and matters which have been rendered soluble. M. Leitenberger's process was made to operate upon the madder-root itself. He first exhausted with water at 45°, afterwards with boiling wood spirit, and these operations he carried out in apparatus perfected and patented by himself.

Mineral oils are now found and worked in other countries besides the United States; just now, Galicia is attracting attention as a valuable source for these oils. In West Galicia, mineral oil abounds; the principal petroleum reservoirs in this tract are found in the mountains enclosed by Limanowa, Neusandec, Grybow, Cieskowice, Gorlice, and Sbyszyce, covering an area of about 20,000 hectares. The ground is so charged with mineral oil, that it frequently issues in the form of springs, and it always suffices to bore 10 or 15 feet below the surface, to encounter the valuable substance. Despite the primitive modes of extraction employed, Western Galicia was able to extract in 1866 about 268 tons weight of petroleum. Several American engineers have visited the country; according to their accounts, the little river Dunajec has a fair chance of becoming the European oil-creek. Geologists and engineers who have carefully examined the country on all sides, consider the petroleum of Eastern Galicia to resemble that of Canada, while that from the western part of the province is almost identical with Pennsylvanian oil. In this latter portion, namely, the western, there are sources of oil which the American wells do not yield in purity and abundance; worked with intelligence, they would doubtless yield such fortunes as those in America have.

At the meeting of the Academy, on the 13th of April, the following memoirs were contributed:—"On the formula of molybdic acid, and on the equivalent of molybdenum," by M. Debray; "On the production of paracyanogen and its transformation into cyanogen," by MM. Troost and Hautefeuille. "The employment of fluoride of calcium for the smelting of phosphide of iron minerals," by M. Caron; "On the crystallisation of sulphur," by M. Schützenberger; from whom there was another memoir, entitled "On some reactions giving place to the formation of oxychloride of carbon;" "On the amides of sulphoxyphosphoric acid," by M. Chevrier; "An addendum, by M. Lecoq de Boisbaudran, to his previous communications upon the supersaturation of saline solutions," completes the list of papers of chemical interest.

It is almost superfluous to say that M. Debray's memoir is one of interest. M. Debray prepared chloride of molybdenum by the direct action of chlorine on the metal gently heated; the product, distilled in a current of dry carbonic acid (to eliminate excess of chlorine), has a deep green colour; it melts at 194°, and boils at 268°. The mode of preparation is similar, and the majority of the characters of this substance agree with a chloride of molybdenum to which Berzelius and others have attributed the formula MCl_2. In all probability this formula was given to the chloride in consequence of the solution, precipitated by ammonia, yielding an abundant precipitate of hydrated binoxide of molybdenum; but the presence still of a large quantity of molybdic acid in the filtered liquor is easily demonstrated. Further, three analyses of this substance have given 35 to 35·2 per cent of molybdenum: the formula M_2Cl_5 requires exactly 35 per cent of metal, while the formula MCl_2 requires rather more than 40 per cent. M. Dumas has accorded to molybdenum, in his work on the equivalents, the number 48. More recently, M. Delafontaine and M. Ullik have, notwithstanding, used the number 46 throughout their researches on the molybdates; M. Rammelsberg also found 46, in reducing molybdic acid by hydrogen, and this number is generally admitted in Germany. M. Debray's results confirm those of M. Dumas. He prepared pure molybdic acid by subliming it in a platinum tube; the sublimation cannot be effected in a porcelain tube, since molybdic acid easily attacks porcelain at the temperation of sublimation. The sublimed acid is extremely bulky, and to enable operations to be made upon a considerable scale it was necessary to transform the acid into molybdate of ammonia: this salt gives by careful calcination an acid both dense and free from lower oxides. The transformation of the acid, which is volatile, into fixed red oxide is effected by heating in a current of hydrogen at the lowest possible temperature; this reduction is made in a glass tube. Under these circumstances a little matter is carried out from the boat, and forms a red ring upon the sides of the tube. This amount of substance is appreciable; it must be carefully withdrawn, and treated successively with nitric acid and ammonia, and the weight determined. The final reduction is effected in a tube of unglazed porcelain, at a very high temperature. As molybdenum attacks the porcelain wherever there is contact, a platinum boat is used, and this prevented from touching the tube by a small piece of platinum foil. Finally, it is necessary to avoid the use of corks and every thing capable of furnishing gaseous carbides. The hydrogen is purified by passing over a long column of copper maintained at a red-heat during the whole time the experiment lasts; it is afterwards dried with fused potash. The porcelain tube M. Debray makes use of is long and furnished with a narrow tubulure, serving to convey the hydrogen. The equivalent deduced from the amount of metal obtained from a given weight of molybdic acid was in one experiment 48·03, in another 48·04, and in a third 47·84. The smallness of the third number is explained by experimental errors. The synthesis of crystallised molybdate of silver enabled these results to be verified. In evaporating slowly in a dark oven, a strongly ammoniacal solution of molybdic acid and nitrate of silver, small regular octahedral crystals of molybdate of silver were obtained. This solution was found to contain a little more silver than that required by the hypothesis $M = 46$, $MO_3 = 70$. By gently evaporating to dryness, and dissolving out the excess of nitrate of silver, the weight of silver not precipitated by the molybdic acid was easily arrived at by precipitating as chloride. The results thus obtained showed $M = 48$, and $M = 47·98$. The molybdate of silver was of course free from ammonia.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

February 24th, 1868.

J. B. Dancer, F.R.A.S., President of the Section, in the Chair.

Mr. Sidebotham sent two beautifully finished water-colour drawings, accompanied by the following note:—

"I send you a couple of drawings of the dry-rot fungus *Merulius lachrymans*, remarkably fine. Mr. Lynde, our treasurer, brought me the specimens, which he had met with during the demolition of some old buildings. The drawings are of the natural size. It is very rarely that such perfect specimens are found, showing, as this one does, the curious structure of the species, and its connection with both the pore and the gill-bearing divisions of fungi."

Mr. Dancer exhibited some sand from the sea-shore at Santos, South America. This sand was remarkably silvery in appearance, a large portion of it consisting of minute plates of mica, and very transparent fragments of quartz, which made it an interesting object for the polariscope. It was rich also in Foraminifera, spines of Spatangus, and fragments of Coralline.

"*Remarks on Molecular Activity as shown under the Microscope*," by J. B. Dancer, F.R.A.S.

The author stated that, during the last 30 years, he had met with many microscopical observers who were not acquainted with the phenomenon, to which the name of molecular action has been given. This class of microscopists had confined their attention to objects requiring a very moderate amount of magnifying power, and generally to dry objects; but when their investigations extended to minute objects immersed in fluid which required powers of 800 to 1500 diameters, they were startled by the appearance of particles in active motion, not moving in a direct line, but vibrating as if attracted and then repelled by each other, some single, and others in clusters.

Many instances have come under the author's notice, in which these objects have been regarded by microscropists as animalculæ. They have given rise to many very ingenious speculations, some of which are connected with spontaneous generation, these observers would have been saved much labour if they had been acquainted with the experiments of the late Dr. Robert Brown on active molecules.

The author does not imagine that the members of this section are wholly unacquainted with the experiments of the early microscopists on this subject, but in the absence of more important matter, he thinks a brief account of the early observations on these so-called active molecules may interest them.

The moving particles had been noticed by Leewenhoek, Stephen Gray, Buffon, and others who supposed them to be animated matter.

In the year 1827, the late Dr. Robert Brown, whilst engaged in the microscopical investigation of unimpregnated ovulum, noticed that the pollen of the clarckia pulchella was filled with particles, which appeared in active motion when immersed in water. These observations were followed by the examination of the pollen of other plants, the particles of which he found to exhibit similar activity. For some time he was exceedingly perplexed with these phenomena, and was disposed to believe that he had really seen in these minute bodies the supposed constituents or elementary molecules of organic bodies, first so considered by Buffon, Wrisberg, Müller, and Milne Edwards, and on examining various animal and vegetable tissues, whether living or dead, he found, as he had expected, that active molecules were visible by merely bruising the substances in water.

Continuing his observations, he found that particles from a bruised specimen of fossil wood appeared to consist entirely of these moving bodies. From this he inferred that these molecules were not limited to organic bodies, or even to their products.

After this he proceeded to examine minerals, simple earths, metals, and many other substances too numerous to mention, and with similar results.

Some writers who commented on these experiments, but who had not carefully followed his communications, asserted that Dr. Brown imagined these particles to be animated,—and this statement was generally believed.

In 1829 the author's late father repeated many of Dr. Brown's experiments, and to prove that these moving particles could not be animalculæ, he placed some crystals and minerals in a crucible which he subjected to a red-heat, ground portions of them to powder, then put it into distilled water, and showed the particles in motion to his scientific friends. It is now well known that all kinds of matter, if reduced to sufficiently small particles, and placed in a medium in which they will not readily sink, will exhibit these movements.

Now, as this phenomenon occurs in the cells of plants, the yolk of the egg, and in decomposing animal and vegetable matter, it is not surprising that the early microscopists, and, indeed, modern ones, should have mistaken them for animalculæ. The particles which exhibit the greatest activity are exceedingly minute, ranging from 10,000th to 30,000th of an inch in diameter; they remain active a considerable time if they are nearly of the same specific gravity as the solution in which they are immersed. One simple mode of producing them is to rub a little gamboge in water, on a glass slide, and place a thin glass cover on it, using a power of from 800 to 1,200 diameters. They can easily be distinguished with less magnifying power, but are not so effectually shown. If they are required for prolonged examination, Dr. Brown recommends that the solution of gamboge be mixed with a little almond oil. The minute globules of water are thus surrounded by oil, and rapid evaporation is prevented.

The cause of the phenomenon is not yet satisfactorily accounted for. Some have imagined that it is the physical repulsion of the particles when uninfluenced by gravitation. The author has tried many experiments with electricity and magnetism without success. He thinks that the movement may possibly be connected with the absorption and radiation of heat.

Those interested in Dr. Brown's experiments and observations on active molecules, can refer to his republished papers in Vol. I. of the Ray Society's publications for 1866.

After the meeting, slides containing active molecules were exhibited to the members.

A conversation took place on the preservation of dried plants, in which Mr. Bailey stated that he uses with success glue with carbolic acid for attaching them to the paper, as a preservation against mites, placing also a few crystals of the dry acid in his cabinet.

Silvering Glass Mirrors.—The process we propose to describe has for its author Prof. Henry Draper, of this city, and may be divided into five operations, viz., the cleaning of the glass, the preparation of the silvering solution, the warming of the glass, the process of silvering, and the polishing. The description is for a 15½ inch mirror. 1. Rub the glass plate thoroughly with aquafortis, and then wash it with plenty of water and set it on edge on filtering paper to dry; then cover it with a mixture of alcohol and prepared chalk, and rub it in succession with cotton flannel. 2. Dissolve 560 grains of Rochelle salt (tartrate of soda and potassa) in 2 or 3 ounces of water, and filter; dissolve 800 grains of nitrate of silver in 4 ounces of water. Take an ounce of strong ammonia of commerce and add nitrate solution to it until a brown precipitate remains undissolved. Then add more ammonia and again nitrate of silver solution. This alternate addition is to be carefully continued until the silver solution is exhausted, when some of the brown precipitate should remain in suspension. Filter. Just before using, mix the Rochelle salt and add water enough to make 22 ounces. The vessel in which the silvering is to be performed should be a circular dish of ordinary tin plate, and coated with a mixture of equal parts of beeswax and rosin. At opposite ends of one diameter two narrow pieces of wood are cemented to keep the face of the mirror from the bottom of the vessel. 3. The glass is slightly warmed by putting it in a tub or other suitable vessel and pouring in tepid water to cover the glass; then hot water is gradually stirred in. 4. Carry the glass to the silvering vessel, into which the silvering solution has been poured, place the whole apparatus before the window and keep up a slow rocking motion. Leave the mirror in the liquid 20 minutes or half an hour, and wash with plenty of water. 5. When the mirror is perfectly dry, take a piece of the softest buckskin, stuff it with cotton, and go gently over the whole silver surface to condense the silver. You may use some of the finest rouge. The best stroke is a motion in small circles; rub an hour. The thickness of the silver thus obtained is about 1-200,000th of an inch.—*Scientific American.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

New Synthesis of Alcohols, and Chemical Structure of Ethylene.—Butlerow and Ossokin have acted upon ethylglycoliodhydrin with zincic methide and ethide with a view of obtaining alcohols, from the nature of which conclusions might be drawn as to the chemical structure of ethylene present in the iodhydrin. The reaction proceeds in the following two stages:—

$$\left.\begin{matrix}C_2H_4I\\H\end{matrix}\right\}O + R_2Zn = \left.\begin{matrix}C_2H_4I\\(RZn)\end{matrix}\right\}O + RH$$

and,

$$2\left(\left.\begin{matrix}C_2H_4I\\(RZn)\end{matrix}\right\}O\right) + R_2Zn = \left.\begin{matrix}C_2H_4R\\(RZn)\end{matrix}\right\}O + ZnI_2.$$

By decomposing the compound last formed with water, the alcohols are obtained, and they were found to be secondary (iso-)propylic—when zincic methide was used—and secondary butylic alcohol—in the case of zincic ethide. It would follow from these experiments that the structure of ethylene is

$$\left.\begin{matrix}CH_3\\CH\end{matrix}\right\};$$

as, however, all other reactions of ethylene lead to the formula

$$\begin{matrix}CH_2\\CH_2,\end{matrix}$$

it is supposed that in the present instance its structure changes from the latter to

$$\left.\begin{matrix}CH_3\\CH\end{matrix}\right\}.$$

—(*Zeitschr. Chem.*, N.F. iii., 680).

Silvering of Glass.—Liebig. After a long series of experiments, the author finally adopted the following process for silvering glass. The solutions employed are:—I. One part of fused argentic nitrate dissolved in 10 of water; II. (a), commercial nitric acid, free from chlorine, neutralised with ammonic sesquicarbonate, and diluted to sp. gr. 1·115; or (b) 242 gr. ammonic sulphate dissolved in 1200 c.c. water (sp. gr. 1·105 to 1·106); III. Solution of sodic hydrate sp. gr. 1·050 prepared from sodic carbonate, free from chlorine; IV. 50 grm. white sugar candy dissolved in little water, 3·1 gr. tartaric acid added, the mixture kept boiling for one hour, and diluted to 500 c.c.; V. 2·857 gr. dry cupric tartrate, covered over with water, and solution of sodic hydrate gradually added till solution has taken place, and solution made up to 500 c.c. These solutions are mixed in the following proportions:—1st, 14 vol. of I., 10 vol. of II., and 75 vol. of III. = 99 vol. of (A) *silvering solution*; 2nd, 1 vol of IV., 1 vol. of V., and 8 vol. of water = 10 vol. of (B) *reducing solution*. The *silvering mixture* is then made by diluting 50 vol. of the silvering solution (A) with from 250 to 300 vol. of water, and adding 10 vol. of the reducing solution (B). If ammonic sulphate has been employed for solution (A) the liquid, after mixing the three ingredients, must be allowed to stand three days before being used; the clear liquor may then be drawn off.—(*Ann. Chem. Pharm. Suppl.*, v., 257.)

On some Compounds of the Toluol-group.—H. Limpricht and H. Schwanert. Toluylene $C_{14}H_{12}$ is converted into dibenzyl $C_{14}H_{14}$ by the action of iodhydric acid. It combines with bromine to $C_{14}H_{12}Br_2$, which on distillation or treatment with alcoholic potassic hydrate changes to bromtoluylene $C_{14}H_{11}Br$. This again combines with bromine forming a crystalline body $C_{14}H_{11}Br_3$. Continued action of alcoholic potassic hydrate removes the whole of the bromine with formation of tolan $C_{14}H_{10}$, a well crystallising hydrocarbon isomeric with anthracene. Tolan forms the bromide $C_{14}H_{10}Br_2$, which is reconverted to $C_{14}H_{10}$ by alcoholic potassic hydrate. Bromtoluylene shows the reaction of the bromide of a diatomic alcohol; with argentic acetate toluylenic acetate

$$C_{14}H_{12}(C_2H_3O)_2O_2$$

is produced, and this is converted by means of alcoholic potassic hydrate into toluylenic alcohol $C_{14}H_{14}O_2$, which is identical with Zinin's hydrobenzoine.—(*Zeitschr. Chem.* N.F. iii., 684).

NOTICES OF BOOKS.

Tea. By E. F. Bamber. London: Longmans. 1868.

The author, who has lived for some years in the tea-producing districts of Asia, has produced a very readable little book. He first goes into the historical part of the subject; then he discusses fully the cultivation of the plant, and the manipulation the leaf undergoes before it becomes an article of commerce, and explains what constitutes the difference between the three classes into which tea may be divided:—*Flowery Pekoe, Green Tea, and Black Tea.*

It is a great pity that a writer who is so fully conversant with his subject should not confine himself to that with which he is familiar, but should diminish the trustworthy character of his book by speaking authoritatively on matters concerning which he appears to be profoundly ignorant. The section in which Mr. Bamber explains the chemistry of tea is remarkable as showing the unhesitating manner in which a writer ignorant of the veriest elements of chemistry will criticise the results obtained by one of the leading chemists of the day. Speaking of Theine, Mr. Bamber writes:—

"Theine cannot be produced artificially. 'Water decomposes this compound easily, and Hydrochloric Acid evaporates from it in warm air, so weak a base is Theine.' In referring to Mulder's analysis, it will be remarked that Muriatic Acid extracts form nearly one-fifth of the whole weight of Tea; and Muriatic Acid and Hydrochloric Acid are synonymous terms."

The following passage is, in our opinion, inimitable:—

"Mulder's analysis is considered the best that has been made of Tea. It appears not to be a very good one; for Muriatic Acid has a strong sour taste, and if Tea had, one-fifth of its total constituents, Muriatic Acid Extract, it should have a strong sour taste, which it has not; probably the Theine in the Tea which he analysed had turned into Muriatic Acid. As a proportional analysis, Mulder's can carry with it but little authority, for the totals of the parts of each of the Teas disagree. Still it has its use, for where Mulder states that there was no trace of a constituent, probably there was none."

The Inductorium, or Induction Coil. By Henry M. Noad, Ph.D., F.R.S. London: Churchill & Sons.

We noticed the first edition of this useful little volume on its appearance in 1866. It gives us pleasure to have the opportunity of here recording the issue of the third edition, containing several additions and improvements. Amongst these we notice a description of Wheatstone's and Siemen's automatic or self-charging electro-magnet, and the ingenious method of utilising the current energy evolved by these machines in the modification constructed by Mr. Ladd. Dr. Noad's description of the somewhat complicated principle involved in these machines is so clear that we are induced to quote it for the benefit of our readers.

On page 32 he writes: "In this curious contrivance the terminals of a revolving armature are (with the intervention of a commutator, to change the direction of the alternate induced currents) placed in connection with the terminals of the electro-magnet coil. Now if the iron body of the electro-magnet were absolutely free from magnetism, no action would issue from the rotation of the armature; but practically that is never the case, for the mass of iron is never absolutely pure and soft; it consequently always retains a small portion of the magnetic polarity which was last induced in it, by the transmission of an electric current through its coil, consequently on the first semi-rotation of the armature, a minute induced current is evolved; but this, in consequence of the connection described, is returned into the electro-magnet coil, and slightly exciting the electro-magnet, a slightly stronger induced current is delivered by the armature, during its second semi-revolution; and so on successively, until the currents induced in the rotating armature acquire a very high degree of energy. If the primary coil of an inductorium be now interposed in the circuit as in Professor Wheatstone's apparatus, sparks of considerable length may be obtained between the terminals of the secondary coil; or a certain length of platinum wire will become incandescent. It may here be remarked that as the energy of the induced currents is augmented, the resistance of the armature to rotation, and consequently the amount of dyamic energy necessary to rotate it is similarly augmented. This fact presents a strong confirmation of the theory that an electric current is merely an undetermined form or mode of energy, and that, by the mediation of the machine here described, dynamic is converted into electric energy."

Mr. Ladd's machine is similar to the above: he employs a second armature, placed between the contrary ends of the plates which constitute the electro-magnet, in which an equal current is induced as in the armature already described; this latter current may be utilised in any required manner.

Mr. Ladd has allowed us to use some of the very beautiful wood-cuts which adorn this book, to illustrate his dynamo-magneto machine which gained the silver medal at the Paris Exhibition, 1867. In this machine (Fig. 1), the ends A of the electro-magnets, B, are firmly screwed to two pairs of iron prolongations, C, forming two cylindrical cavities in which the two armatures, *m*, *n*, are rotated in the same direction by two bands passing over a common drum. The armature, *n*, returns its currents into the electro-magnet, while the currents from *m* are utilised, as in producing the electric light between the carbon terminals, D.

In another form of the apparatus constructed by Mr. Ladd, the two armatures of the former are combined in one, and the coils are wound at right angles to each other as shown at A and B in Fig. 2.

Of these coils the shorter, B, feeds the electro-magnet, and the longer, A, furnishes the utilised current.

The results to be derived from these dynamo-magneto machines are always in proportion to the power expended, and the only limit appears to be the rapidity with which the armatures can be rotated.

Mr. Beanes's ozone generator, of which so much has been heard and so much more is expected, is here described. The object for which it was made was to produce ozone in very large quantities, so as to apply it to commercial purposes, such as decolourising sugar, oils, rags, &c. For this purpose an apparatus was made as follows:—"Thirty plates of thin glass 18 in. by 9 in., each plate being coated with tinfoil on one side and separated from those next it by slips of glass placed along two edges so as to leave a series of thin broad channels, for the passage of the air to be ozonised, each coating being alternately connected together in a similar way to a condenser of an inductorium; the whole is then placed in a well-made box thoroughly protected with shellac to prevent the ozone acting upon the wood; the box is left sufficiently long to allow of two openings, one at either end beyond the glass plates, for the passage of a current of dry air; the ends of the box have glass plates inserted for observation. The area between the plates in the above apparatus was about 14 square inches; the two terminals of the coatings are insulated through the box, and when connected with a good inductorium, a glowing discharge will be seen between the plates of glass, and as one discharge is sufficient to ozonise the air at that instant between the plates it is evident that a very rapid blast can be sent through, and an enormous quantity of ozone obtained; it is essential that the air should be cold to properly ozonise, but a moderate amount of heat afterwards does not affect it. The pipes conveying the ozone should be of lead, tin or, glass; there are but few other substances that are not affected by it."

Fig. 1.

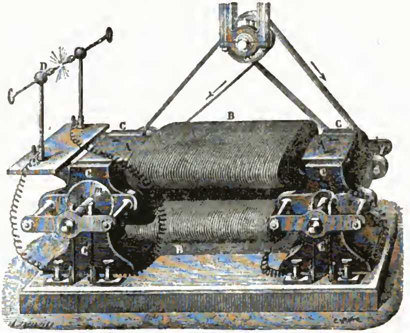
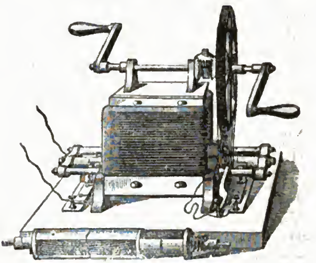


Fig. 2.



Braithwaite's Retrospect of Medicine. Vol. lvi.

For more than a quarter of a century this most useful compilation has rendered good service to the medical profession. The present volume contains no fewer than six papers, amongst others from the authoritative pens of Lister, Syme, and Sir J. Y. Simpson, "On the Application of Carbolic Acid to Practical Surgery." Whether according to Pasteur, carbolic acid acts by destroying the septic organisms which probably in myriads infest the air of hospitals, or whether, according to his antagonist Pouchet, it operates in some undetermined manner, by preventing oxidisable matter passing into a putrid condition, certain it is that this agent is effecting a beneficent revolution in surgery. A large proportion of the disasters and deaths which arise from compound fractures, wounds, and amputations, is caused by the decomposition of blood and sloughs. The evidence contained in this retrospect shows that carbolic acid, properly employed, prevents this corrupting change, and warrants the assertion that the boon which chemistry has conferred on medicine will avert a measureless amount of suffering and death.

CORRESPONDENCE.

ORGANIC MATTER IN WATER.

To the Editor of the Chemical News.

Sir,—A little consideration of the action of permanganate of potash on organic matter will, I think, show the fallacy of the supposition that the quantity of a standard solution used is in direct ratio to the weight of organic matter present in water; unless we come to the unwarranted conclusion that the organic matter in water is homogeneous. Suppose two waters contain exactly the same weight of organic matter, W say, and that this weight is distributed among the elements carbon, hydrogen, oxygen, and nitrogen, in such a manner that, in the one case—

$$W = pC + qH + rN + sO,$$

and in the second case—

$$W = p'C + q'H + r'N + s'O.$$

Suppose that the permanganate exerts its full oxidising action, so that all the carbon is changed into carbonic acid, and all the hydrogen into water. Let O denote the quantity of oxygen required in the first case, and O′ the quantity in the second. Then, if O″ denotes the quantity of oxygen contained in each measure of the standard solution, we shall have $PO'' = O$ and $P'O'' = O'$, where P denotes the number of measures used in the first case, and P′ the number in the second case. We shall then have the following equations:—

$$PO'' = (pC \times 2\tfrac{2}{3} + qH \times 8) - sO,$$

and in the second case—

$$P'O'' = (p'C \times 2\tfrac{2}{3} + q'H \times 8) - s'O.$$

According to the permanganate method of estimation, we should have the equation $P = P'$, and consequently, $PO'' = P'O''$. A result which is very remote, and which evidently requires the extraordinary supposition that, whilst the total weight of organic matter remains the same, the four quantities vary so among themselves, that the quantity of oxygen consumed remains constant. For the sake of the simplicity of the example, suppose that the organic matter consist of carbon and hydrogen only, and that two waters contain each, in an equal bulk, 5 gr. of organic matter, distributed as follows:—In the first case, $3\frac{3}{4}$ gr. of carbon and $1\frac{1}{4}$ gr. of hydrogen; and in the second case, $4\frac{2}{7}$ gr. of carbon and $\frac{5}{7}$ gr. of hydrogen. Our equations would be—

$$PO'' = 3\tfrac{3}{4} \times 2\tfrac{2}{3} + 1\tfrac{1}{4} \times 8 = 20.$$

$$P'O'' = 4\tfrac{2}{7} \times 2\tfrac{2}{3} + \tfrac{5}{7} \times 8 = 17{\cdot}14.$$

Thus the number of degrees of permanganate used in the first case would be to the number used in the second, as 20 : 17; and it would be inferred that the quantities of organic matter were in this ratio, whereas the weights were equal. If, on the other hand, the permanganate of potash does not exercise its full oxidising power, but reduces the organic bodies present to forms of less complexity, it is evident no reliance can be placed upon an agent of such uncertain action.—I am, &c.,

James Bottomley, B.A.

Queenwood College, near Stockbridge, Hants.
April 22nd, 1868.

PERMANGANATE AS A SANITARY WATER-TEST.

To the Editor of the Chemical News.

Sir,—Owing to the Easter holidays, I have been unable sooner to make answer to the remarks which have been addressed to me in the Chemical News, by Mr. Spencer and Professor Attfield.

To the former, I would reply that I was well aware of the fallacious indications which the presence of iron, in solution, in water may occasionally cause permanganate to give; but, as I was not recommending that substance for analytical purposes, but merely as a sanitary water-test, well suited for popular use, and did not pretend to give directions for its employment, and the correction of possible errors, I did not consider it necessary to allude to them. To prove, however, that I had not overlooked this source of fallacy, I will quote a passage from a communication of mine on this subject, which appeared in the *British Medical Journal* of the 15th of February last. "The presence of deleterious organic impurities in water," I said, "will rarely or never fail to be detected by the addition of permanganate solution. Other less dangerous or innoxious oxidisable matters, as iron, for instance, may no doubt occasionally cause a comparatively inoffensive water to be suspected of being hurtful; but it is barely possible that when really dangerous matter of organic origin is present, the permanganate will allow it to escape detection. It may leave comparatively untouched other organic matters, but these will assuredly be the more sound and stable substances which are incapable of producing the 'horrible results' that are sometimes occasioned by unsound and decomposing matters."

When iron is present in such quantity as to cause erroneous indications, it will usually be detected by the palate. The taste communicated to water by even very minute quantities of iron, is one which most people would at once recognise. This source of error being known, nothing is easier, for a person possessed of only a smattering of chemical knowledge, than to determine whether the decolouration of the permanganate arrises from iron. But the grand object of a popular water-test, so far as organic matter is concerned, is to afford the public a ready and simple means of detecting and rejecting water that may prove prejudicial to health. This the permanganate test satisfactorily accomplishes. If its use may sometimes lead to the temporary rejection, as unwholesome, of water charged with nothing worse than iron, the mistake will be on the safe side, and can never give rise to injurious results.

The popularisation of the permanganate test would assuredly tend to put an end to the occurrence of those outbreaks of fatal disease which are caused by the use of polluted water; and if this result were obtained at the expense of the occasional rejection of an innoxious water, it would be very cheaply purchased. But, what is more, the popular use of this substance would not only prove an effectual safeguard against those accidents to the public health which arise from the use of befouled water, but would afford the means of extemporarily purifying such water, and rendering it fit for consumption. Water that has been treated by permanganate will be found to be deprived of putrescible matter. Even repulsively foul water, after purification by this means, is not liable to become offensive. Permanganate solution, therefore, is not only of great value as a popular test for polluted water, but a safe and reliable means of freeing potable water from deleterious putrescible matter.

To Professor Attfield, I would reply that I am quite ready to admit that, instead of having proposed a new method of detecting organic pollution of water by the olfactory sense, as I, it seems, erroneously put it, he has merely suggested an improved means of rendering the nose a more efficient detective. As stated in my former communication, I consider Professor Attfield's suggestions on this subject well worth knowing, and I give that able chemist every credit for freely offering them to the general public. When he found fault with my letter in the Chemical News of the 3rd of April, for being similar to one which had appeared previously in the *Medical Times and Gazette*, he was not, perhaps, aware that the communication which called it forth had already appeared almost verbatim in another periodical.—I am, &c.,

J. Muter.

SCIENCE TEACHING IN SCHOOLS.

To the Editor of the Chemical News.

Sir,—In the last number of this journal, your correspondent "D." criticises some lectures of mine recently given at Eton College, and I feel constrained to offer a word in reply, although it is to be wished that the writer had given his name in full.

It would appear to be unwise to judge of the nature of a course of lectures from the concluding sentences of the last lecture, because a generalisation founded upon the assumption that the whole is similar to an infinitely small part cannot be very trustworthy. In the case in point, the small part differs materially from the whole, because the concluding portions of a course of lectures, to a greater or less extent, summarise the matter of the entire course, and usually give the more plausible and dominant deductions. A work on arithmetic may commence with simple addition, and end with adfected quadratic equations; but it would be obviously an erroneous practice to deduce the nature of the whole book from its last chapter. As in the book, so in the course of lectures; we ascend from simple matters to those which are more difficult:—"*Neque enim in plano via sita est,*" says Francis Bacon, "*sed ascendendo et descendendo; ascendendo primo ad axiomata, descendendo ad opera.*"

"If we may judge of the lectures themselves," writes "D.," "from these extracts, I would say that such lectures are not adapted to attract boys to science." Allowing for a moment, for the sake of argument, that the lectures may be judged of from the extracts (which I trust has been disproved above), I may say that I fully concur with "D." "that such lectures are not adapted to *attract* boys to science." They would not be fulfilling their object if they sought to do this; for if science, in its plain unvarnished form, does not present sufficient attractions to the student, it ill becomes the teacher to make it externally showy and factitiously attractive, while the reality must ever remain the same. It would be like binding a book, on say, Hebraic punctuation, in the same kind of binding as a popular novel. Those who require to be attracted to science by forced means can never study it with advantage, nor should we ask such to commence the study.

I do not mean to say that lectures on natural science should be sparsely illustrated by experiments; there should always be a sufficiency, and there is a limit in both directions. A lecture which is insufficiently illustrated is quite as bad as—some would say worse than—one which is over-illustrated; in the latter, there are so many experiments, that it is impossible to have them properly explained; in the former there is too much dry explanation, which could as well be acquired from a book. It is the happy mean that we all desire to attain. A lecture on natural science can rarely be sufficiently illustrated by less than fifteen experiments, and it is usually over-illustrated when the number of experiments exceeds twenty-five.

Because science happens to be popularised in certain places and in certain well known magazines, there is a general impression that it is to be viewed as an amusement, and that it does not require serious study and application to master it. Nothing can be more erroneous. Until this idea is disproved, natural science can never be taught in schools with advantage. If science is to be taught at all, it must receive from the pupil as much attention as he gives to Latin and Greek; it must not be regarded as an amusement or light study; notes must be taken, and themes must be written after each lecture, and a two-hour examination must be held at the conclusion of the course. Popular science is as much out of place in a school as popular Greek would be. To popularise a thing, is usually to degrade it. It is indeed right for us to rend the dark veil of the temple of nature, so as to expose the shrine to the worshippers without; but I think it is unnecessary to make the shrine garish with a false lustre.—I am, &c.,

G. F. Rodwell.

ESTIMATION OF POTASH.

To the Editor of the Chemical News.

Sir,—With reference to the abstract of our paper on the "Estimation of Potash," which appeared in last week's impression, we beg to state that on account of its requiring to be posted here on the evening following that on which it was read, we were unable to revise it.

Will you therefore kindly allow space for the following corrections in this week's issue, in order to prevent the necessity of any remarks or correspondence on the part of your numerous readers?—We are, &c.

The Authors.

Corrections.—Col. 2nd, line 10th from bottom, read *sulphate* of soda. Col. 3, line 12 from bottom, read *hydric sulphate or hydric chloride.* Col. 3, line 17, read *precipitates and evaporated washings.* Col. 4, line 12, read to dissolve the *pure potassic chloride.* Col. 4, line 13, introduce the following paragraph:—

"The method which we ultimately adopted for purifying recovered platinum, is that by reduction with alcohol and excess of sodic hydrate, washing, boiling with hydrochloric acid, washing, drying, and simply igniting the resulting platinum black, and finally boiling with nitric acid and washing. This method invariably gives excellent results when the platinic solution is tried on pure potassic chloride."

Col. 4, line 23, read, the authors object to the method of *weighing* small quantities (as 10 grs.) of dried salts. Col. 4, line 11 from bottom, read, ·19313 and 1·582493.

DEATH BY ELECTRICITY.

To the Editor of the Chemical News.

Sir—I perceive you have a paragraph on the above in your last number of the Chemical News, being an alleged new form of capital punishment, by a writer in *Harper's Weekly*.

I beg to inform you that I am the original proposer of the above; in June, 1863, I suggested to the Conservateur des Abattoirs à Paris this method for slaughtering cattle; through insufficient address, this letter was returned to me by the "dead letter office." February 17th, 1865, you published my suggestion in the Chemical News, page 84.

In May, 1866, the Royal Society for the Prevention of Cruelty to Animals wrote to me that "they will be glad to appoint a deputation to attend any experiments I may desire to make, and that they will procure the permission of a butcher for the trial." This fell through because I had neither the apparatus nor the time to carry it out.

In 1866 I proposed this scheme to His Grace the Duke of Richmond, to be used instead of hanging, in capital punishment, conjointly with the suggestion that executions should take place in private, for which I gave my reasons why I considered it more expedient than the present mode. I also used the following words—"Simultaneously with the shock, the wretched being would pass into eternity without a pang."

I have condensed my letter as much as possible, and in conclusion beg a place in your journal, in common fairness to myself.—I am, &c.,

Chas. N. Ellis.

Wolverhampton, April 29th, 1868.

MISCELLANEOUS.

TECHNICAL EDUCATION.

The Chemical News, we think, may be justly proud of the fact that it was the first journal to introduce this subject to the English reading public. The question has been warmly taken up both by the medical, weekly, and ordinary daily papers, numerous articles have been written upon it, and a number of scientific gentlemen have formed themselves into a committee for advocating its adoption in England, For this really very considerable amount of progress we have to thank mainly the British Association for the Advancement of Science; and if a scheme is promptly drawn up, and as promptly carried out, for the fulfilment of the objects in view, the credit resulting to the Association will be one of the greatest in the series of its already great triumphs.

The public must do scientific men the justice of acknowledging that they have not been slow on their part in urging this matter, the result of its neglect every one now admits to be most disastrous; let us not, therefore, wait for something worse by letting these questions now die out by want of discussion. The recognition of a defect is the first step towards its remedy, and that the recognition has been given any one may judge from the daily press; we quote the following from a publication of great promise, *Beeton's Journal*, which is intended to obtain, and we believe has already done so, a wide circulation among the boys of our large colleges and schools:—

"However soon we may set technical schools going, we cannot bring the knowledge so acquired to bear for many years. Our hope must be in the rising generation of Englishmen. They should think, *think* over these mechanical arts; they should view them as a noble study. Every fresh labour-saving machine means another class of men raised from degrading toil to healthy independence; from a position where the mind is robbed, it may be, of all chance of improvement, to one where the mind is employed and the body saved. And it means, moreover, a new source of wealth to the country, and a new vantage-ground over foreign states.

"If the spirit of the great inventors is to slumber through the rising generation, then, when our great men do arrive, we shall probably be too far behind in the race to make good our lost ground. But this ought not to be. The new generation sees the works of the giants of other days; it reads of their doings. It has not the same fear of leaving their beaten paths, of departing from their practice, which may be supposed to have deadened the inventiveness of the pupils of the great men themselves. There are great things waiting to be invented. There are fame and wealth to be won. But we want something altogether new and wonderful, something to set our hearts beating as our fathers' beat at the electric telegraph, not to set our brains calculating the dividends to be made by sending messages. Something grand, and with an interest apart from money."

It should not be forgotten that the question of technical education for workmen and their employers must be regarded as inseparable from that of scientific education; in the higher classes of society, the one without the other is quite valueless. It may be freely granted that technical education is encouraged abroad and neglected at home; the evil result is admitted to be of magnitude; but few results of this kind are due to one cause only, and a further cause, and in the main, not a less effective one, is the want of recognition that is awarded socially and politically to men of science generally. Science requires support by State grants, Parliamentary representation, and introduction into schemes of general education, for its proper development in England. It is sufficient merely to indicate the ground that should be taken up by all scientific men, and we have endeavoured to supply them in this journal with the materials necessary for a clear expression of facts as they stand. When such materials are afforded as data, we can safely omit all comparisons, and there need be no fear that the verdict of all thinking men will be otherwise than a unanimous one.

We begin, then, with the report that has been drawn up by Dr. Bahin upon the technical schools of France; we only wish that there existed in England an official blue book drawn up by competent commissioners.

"Of the many institutions in France devoted to technical education the *Ecole Centrale des Arts et Manufactures* stands highest. It enjoys a world-wide reputation, as pupils flock to it from all parts of the civilised globe. It was founded in 1829 by a private Society of eminent scientific men for the purpose of training civil engineers and managers of industrial work and manufactories. It has well sustained its reputation; from a private it has gradually risen to the importance of a national institution, by raising industry to the rank of the liberal arts, and by creating, as it were, a new faculty. The instruction provided here is not only theoretical, but eminently practical, as most of the professors are former pupils of the school, who, after devoting many years to practical work, return with this additional experience, to carry out those sound methods of instruction under which they themselves were formed. The pupils of this school are not all drawn from the richer classes, but are to a certain extent recruited from the workshops. The principle of assisting poor but deserving students forms a striking feature in its organisation. I quote the following words from the prospectus:—"To give to a young man, poor but talented, the means of developed his faculties, to endow the country with an industrious man who will know how to draw fresh wealth from it, is not only a good action, but a good investment." The government, the local authorities of the departments, and the *Société d'Encouragement* have each contributed towards this noble work. The course of study extends over three years. Candidates for admission are required to pass satisfactory examination in elementary mathematics and composition. The studies of the first year are general and obligatory upon all pupils. They form a suitable preparation for the succeeding years, and enable each pupil to select the special branch of industry for which his taste and capacity best adapt him. The selection must be made at the beginning of the second year. The studies are then divided into four sections—1. Machinery; 2. Physical science; 3. Chemistry; 4. Mining and metallurgy. The pupils undergo special examinations during the year, and a general one at the end of each year, which serves to determine their fitness for passing from a lower to a higher grade. Those who at the end of the course satisfy all the examination tests receive diplomas; and those who satisfy only a certain number receive certificates of capacity. These diplomas and certificates are the sure introduction to honourable and lucrative employment, affording thus a valuable criterion of the estimation in which the school is held, and of the importance of the work which is done in it.

Next in importance are the Ecoles impériales des Arts et Métiers of Aix, Angers, and Châlons. These are essentially Government schools, established for the purpose of training foremen and managers of workshops and skilled artisans. Each school draws its pupils from a certain number of departments, of which it is the centre. Applications for admission must be addressed to the prefect of the department in which the candidate resides, accompanied by certificates of birth, health, good conduct, and general aptitude for some mechanical labour. Admission is obtained only after passing two examinations. The first is both oral and written, and comprises reading, writing, arithmetic, elementary geography, geometrical drawing, and the drawing of ornament; and, in addition, each candidate is required to execute some piece of work in wood or iron, in connection with the trade which he has been learning. The second examination is entirely oral, and limited to the subjects of the first. The following details are worthy of note:—Pupils are received only as boarders, at an anuual payment of twenty-four pounds. The parents of poor but successful candidates, on addressing a formal application to the minister, are exempted from paying either the whole or a certain proportion of this sum, according to their means. The course of instruction extends over three years, and is both theoretical and practical. The former comprises arithmetic, algebra, trigonometry, descriptive geometry, mechanics, drawing, and grammar. The latter is carried on in four workshops, and includes carpentry, smithery, casting, and fitting. Prizes are awarded at the end of each year to the most deserving pupils, and certificates at the end of the course to those who acquit themselves satisfactorily; and, if any specially distinguish themselves, they receive in addition a silver medal. In the eastern departments of France, which abound in manufacturing industry, the benefits of technical education have been widely extended. At Mulhouse, one of the principal centres, there are several important schoolls, founded and maintained by the munificence of the leading manufacturers.

The Ecole Professionnelle renders valuable services to the cause of industrial progress by the variety and extent of its educational programme. It comprises five divisions —1. An elementary division, in which languages, mathematics, and the principles of science are taught. 2. A special division, where, in addition to the higher branches of the above subjects, practical science is taught in the workshops, under the direction of an engineer and two foremen. 3. A commercial division. 4. An industrial division, where the instruction is chiefly practical, and carried out in the workshops, the chemical laboratory, and the schools for spinning and weaving. 5. An upper division, serving as a complement to the second and fourth divisions, and preparatory to the Ecole Centrale. In the practical department of dyeing, printing, spinning, and weaving, the pupils are initiated into all the most recent improvements, and, under the guidance of an experienced professor, they pay periodical visits to all the great industrial establishments in the neighbourhood. There is also a special school at Mulhouse for teaching the theory and practice of power-loom weaving established under the patronage of the Industrial Society. The school was called into existence for the express purpose of stimulating improvement in this branch of industry. Connected with it is a complete working establishment, to which the pupils are admitted, only after the satisfactory completion of their studies, either as working weavers or overseers. This establishment also becomes a valuable medium between inventors and manufacturers, by undertaking to examine and report upon all new inventions and improvements brought before it, and by helping to secure their immediate adoption in all cases where their merits are duly recognised.

No sketch of technical education in France would be complete without some notice of the Conservatoire des Arts et Métiers. This is a vast museum of the accumulated industry of the country, and in connection with the Exhibition, merits a very careful inspection. The principal objects in the collection are, models of the tools and operations employed in almost every trade; models of building construction, machinery and engineering; also, models illustrating all sorts of manufacturing processes, such as the working of iron and the reduction of metallic ores. The collections of physical and chemical apparatus are very valuable, and serve to illustrate in a remarkable degree the progress of scientific discovery.

NOTES AND QUERIES.

Extraction of Grease by Bisulphide of Carbon.—If "C. L. W." will apply to "E. S.," care of Messrs. Parry and Garnham, 12a, Wellington Street, London Bridge, he may obtain all necessary information regarding this subject, also concerning the apparatus employed for the purpose.

Extraction of Grease by Bisulphide of Carbon.—If your correspondent, "C. L. W.," will apply to Mr. Jesse Fisher, Ironbridge, Salop, I have no doubt he may obtain the information that he requires.

Extraction of Grease by Bisulphide of Carbon.—"C. L. W." will find whatever information he desires on this subject by inspecting at the library of the Commissioners of Patents, Southampton Buildings, Chancery Lane, the numerous patents taken in reference to this subject, amounting to several dozens; it does not appear that, either in this country or abroad, there is any process in use which is not subject to Patent right.

Extraction of Grease by Bisulphide of Carbon.—Having had considerable experience in the employment of bisulphide of carbon as a solvent in manufacturing operations, I think I might be of use to your correspondent C. L. W., in respect to the apparatus which he requires.—H. B. Condy.

Lithia.—I have access to an almost unlimited supply of lepidolite, and wish to know the best means of utilising it for the lithia it contains. Will any of your courteous friends on the other side of the Atlantic, kindly inform me how best to set about this? I see from an announcement in our reprint of your invaluable journal that you will extend the same favours to American Correspondents that you have long granted to English ones.—O. K. Y., Tenessee, U. S. America.

MEETINGS FOR THE WEEK.

Monday.—Royal Institution. General Monthly Meeting, 2.
Tuesday.—Royal Institution. Dr. M. Foster, "On the Development of Animals," 3.
Wednesday.—Society of Arts, 8.
— Geological. Alfred Taylor, Esq., F.L.S., F.G.S., "On the Quaternary Gravels of England." S. V. Wood, Jun., Esq., F.G.S. "On the Pebble-beds of Middlesex, Essex, and Herts." Dr. J. Schmidt. Communicated by Sir R. I. Murchison, Bart., K.C.B., F.R.S., &c., "On the Eruption of the Kaimeni of Santorin." 8.
Thursday.—Royal Institution. Professor Bain, "On Popular Errors," 3.
— Royal, 8½.
— Chemical. Mr. C. W. Siemens, "On the Regenerative Gas Furnace as applied to the Production of Cast Steel," 8.
— Royal Society Club, 6.
— Astronomical, 8.
Friday.—Royal Institution. Mr. C. Greville, Williams, "On the Artificial Formation of Organic Bodies," 8.
Saturday.—Royal Institution. Professor Bain, "On Popular Errors," 3.

TO CORRESPONDENTS.

Communications have been received from J. Sillett; W. F. Barrett; W. Bywater; H. Grubb; J. Samuelson; J. Horsley; A. Liversidge; W. Bartlett (with enclosure); Dr. B. H. Paul (with enclosure); J. B. Bird (with enclosure); P. Holland (with enclosure); G. F. Rodwell (with enclosure); H. B. Sykes; W. Kinder; O. Philips; J. Solomon; G. Spencer; G. Benson; The Master and Wardens of the Society of Apothecaries (with enclosures); H. B. Condy; Thos. Spencer; Dr. Adriani; H. Gregory; G. Stephens; W. Ladd (with enclosure); E. J. Lloyd; J. A. Wykes; S. A. Sadler; J. Alexander; W. Walker; Dr. M. Reimann; W. Butler; Dr. G. E. Day, F.R.S.; A. Hensman; H. H. Watson; W. Thompson; J. C. Braithwaite; Murray & Heath; F. C. Calvert & Co.; A. McCulloch; G. W. Eeeles; Muspratt, Brothers, & Huntley; Sydney Gibbons, Melbourne; D. Marples; E. Yendale; C. Horner; J. C. Brough; G. Fletcher & Co.; A. C. Bowdler; H. Baillière; G. Dickens; H. Streeter; J. Kemp; Dr. Odling, F.R.S.; Dr. Fraser, Nova Scotia.

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ON THE ESTIMATION OF NITRIC ACID.

(Pelouze's Method.)

By PHILIP HOLLAND.

Of the various processes from time to time proposed for the estimation of nitric acid in combination, there are three which may be said to be in some measure related, viz., those of Pelouze, Schlœsing, and Walter Crum. In the two first the weighed nitrate is boiled out of contact with air with a solution of protochloride of iron and an excess of hydrochloric acid. Under these conditions the N_2O_5 splits up on the one hand into oxygen gas which indirectly by depriving the hydrochloric acid of its hydrogen admits of the conversion of the protosalt of iron into a persalt, and on the other into a lower oxide of nitrogen which escapes. The reaction being a definite one obviously affords two methods for estimating nitric acid. We may either determine the iron oxidised, which forms the basis of Pelouze's process, or we may after Schlœsing reconvert the nitric oxide into nitric acid by the addition of oxygen, and titrate with an alkali in the usual manner. In Crum's method the nitrate together with a sufficiency of sulphuric acid to decompose it is agitated with mercury, whereby a reduction is effected with formation of nitric oxide as in the preceding instance. Of the three processes I have enumerated Schlœsing's is valuable to the analyst, whose object it is to determine our acid when in the presence of organic matter; it does not appear to have come into general use, this is perhaps to be accounted for by the fact that the operations it involves are rather tedious, and somewhat difficult of execution. Since the method of Pelouze is extensively practised, a description of a simple apparatus for its successful prosecution may be interesting. Before I describe my apparatus I will notice the process as it stands at present.

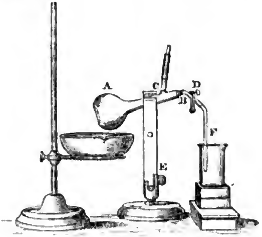
What are its absolute requirements? Two; firstly, that the decomposition of the nitrate shall take place in an atmosphere of which oxygen does not form a part, and secondly that such decomposition shall be complete.

I need not describe the method as set forth in Fresenius; it is familiar to all. The author conducts the operation in a retort, through which he passes a current of hydrogen. Attached to the stem of the retort is a U-tube, containing a little water, which serves as a lute to prevent access of air.

In the modified arrangement I am about to describe, the operation is conducted in vacuo, and at its termination the solution is boiled to expel the nitric oxide, thus avoiding the necessity of employing either hydrogen or carbonic acid.

In the accompanying sketch, A, is a long-necked assay flask drawn off at B, so as to form a shoulder, over which is passed a piece of French india-rubber tube, D, about 6 centimetres long, the other end terminating in a glass tube, F, drawn off so as to leave only a small orifice. On the elastic connector D is placed a screw compression clamp. At C, a distance of 3 centimetres from the shoulder, is cemented with the blow-pipe a piece of glass tube about 2 centimetres long, surmounted by one of French tube rather more than twice that length. The elastic tubes must be securely attached to the glass by binding with wire. After binding, it is as well to turn the end of the connector back and smear the surface with fused caoutchouc, and then replace it.

This device is recommended by Dr. Sprengel for securing an air-tight oint. The wooden clamp E gives support to the flask; the rest of the arrangement requires no explanation.



The analysis of a nitrate is conducted as follows:—A small funnel is inserted into the elastic tube at C, the clamp at D being for the time open; after the introduction of the solution followed by a little water, which washes all into the flask, the funnel is removed, and the former placed in the inclined position it occupies in the figure. The contents are now made to boil so as to expel all air and reduce the volume of the fluid to about 4 or 5c.c. When this point is reached a piece of glass rod is inserted into the elastic tube at C, which causes the water vapour to find egress through F.

Into the small beaker is put 50 c.c., more or less, of a previously boiled solution of protosulphate of iron in hydrochloric acid. (The amount of iron already existent therein as a persalt must be known).

The boiling is still continued for a moment to ensure perfect expulsion of air from F, the lamp is then removed, and the caoutchouc connector slightly compressed with the first finger and thumb of the left hand. As the flask cools the solution of iron is drawn into it, when the whole has nearly receded the elastic tube is tightly compressed with the fingers, whilst the sides of the beakers are washed with a jet of boiled water, which is also allowed to pass into the flask. The washing may be repeated, taking care not to dilute more than necessary or admit air. Whilst F is still full of water, the elastic connector previously compressed with the fingers is now securely closed with the clamp, the screw of which is worked with the right hand. Provided the clamp is a good one, F will remain full of water during the subsequent digestion of the flask.

After heating at 100° for half an hour the flask is removed from the water-bath and cautiously heated with a small flame, the fingers at the time resting on the elastic connector at the point nearest the shoulder; as soon as the tube is felt to expand, owing to the pressure from within, the lamp is removed and the screw clamp released, the fingers maintaining a secure hold of the tube, the gas flame is again replaced, and when the pressure on the tube is again felt, this latter is released altogether, thus admitting of the escape of the nitric oxide through F, which should be below the surface of water in the beaker whilst these manipulations are performed. The contents of the flask are now boiled until the nitric oxide is entirely expelled, and the solution of iron shows only the brown colour of the perchloride. At the completion of the operation the beaker is first removed, and then the lamp.

It now only remains to transfer the solution of iron to a suitable vessel, and determine the perchloride with chloride of tin in the usual way.

A mean of six closely approximating experiments for the percentage determination of N_2O_5 in pure nitre gave 53·53 per cent instead of 53·41. The process is easy of execution, and gives satisfactory results. The points requiring attention are that the apparatus should be capable of retaining a sufficiently perfect vacuum during the operation; this condition is fulfilled by the use of suitable elastic tube and clamps. What is known as French tubing serves the purpose well; its sides are thick, and its material free from metallic oxides.

It is advisable when making the digestion at 100° to place the flask in cold water which is afterwards raised to the boiling point; if this be not done, but on the other hand the flask is heated at once, a violent bumping ensues, and portions of the liquid are projected into the tube at c.

I find it necessary to standardise the chloride of tin at the time the analysis is made; it appears to be liable to constant change. 10 c.c. of my solution originally equalled ·04162 of N_2O_5; the second day the numbers were ·03947; whilst on the third day ·0364 was a mean of two titrations. Particular precautions were not taken to preserve the solution, otherwise perhaps the numbers would not have presented so great a dissimilarity.

Chorley, April 23rd.

ON MUSICAL AND SENSITIVE FLAMES.

Abstract of a Lecture delivered, at the invitation of the Council, before the Dublin Royal Society, on January 3, 1868, by W. F. Barrett, *Natural Science Master at the International College, London, &c.*

One of the earliest natural facts which arrests the attention of a thoughtful mind is the stability of the wonderful universe in which we live. This permanency is, nevertheless, the product of incessant change; for nothing is absolutely at rest. The secret of the stability of nature, its unresting repose, is found in the fact that the motion is regular—the change is periodic. Atoms, as well as planets, have their period of revolution. Hence, sooner or later, in the physical world at any rate, phenomena repeat themselves. Like a vast living body the throbbings of the universe announce the accord of its varied parts. This rhythmic flow of nature constitutes most literally the "Music of the Spheres." Not this, but a less ethereal music, I have had the honour of being invited to bring before you this afternoon.

The so-called musical or singing flames were discovered nearly a century ago by a native of this city, Dr. Higgins, who found, that when a flame of hydrogen was burning within a glass tube the flame emitted a musical note. The experiment was repeated; and it was moreover shown that glass tubes were not necessary, for similar sounds, though of different quality, were produced when metal or pasteboard tubes were employed. Neither was it necessary to use hydrogen, for a small flame of common coal gas gave a musical note when burning within a tube.

The cause of this phenomenon had been investigated by many, but most successfully by an illustrious man who had lately passed from among us—a man who had left behind him a name as good as it was great, and who possessed a mind as simple and child-like as it was sagacious and profound—the late Professor Faraday. This subject had been one of Faraday's early *flames*. The cause was shown to be due to the fact that the gas, in issuing from the burner, did not burn silently. It rustled in passing through the orifice of the burner, and in burning it made a continuous series of inaudible explosions. This was proved by several experiments, for, by suitable means both these causes could be exalted so as to become sensible. The resonance of the tube placed over the flame renders audible all the sounds of a certain pitch made by the gas. By a series of experiments it was then proved that any noise, if made regularly and with sufficient rapidity, was converted into a musical note. Thus rough and rude taps and hard and harsh explosions could be chased into perfect melody by mere rapidity of succession.

The condition of the flame when burning within the tube was shown by a moving mirror. It was seen that when the flame was silent, and the mirror moving, a band of light was produced, but when the flame was sounding, this luminous ribbon was broken up into a series of disjointed images of flame. The effect of lengthening the tube in which the flame was burning was next shown, and a series of gas jets burning within glass tubes of varying length gave a corresponding series of musical notes of varying pitch. By placing the finger upon the top of these tubes the sound could be quenched, and thus a novel musical instrument could be constructed. From glass tubes the lecturer passed on to show the effects of flames burning within extremely long tin tubes. Within a tube 6 ft. long, and about 1½ in. in diameter, the flame of a large gas burner gave a loud unmusical roar. By adding to the end of this tube a glass chimney, it was seen that when the flame was sounding it was broken up into wild confusion. By enclosing a still larger gas flame from a huge Bunsen's burner within a tube 18 ft. long and 3 in. diameter, a deep roar was obtained, intermingled with loud reports similar to the discharge of musketry.

Returning once more to the gentler music of the small glass tubes, two flames, enclosed in their respective tubes, were taken and made to emit notes of the same pitch. This point was gained by shifting to and fro a paper slider, which moved stiffly at the upper extremity of one of the tubes. When the notes were nearly in unison a series of intermittent sounds or *beats* were obtained, due, as is well known, to the mutual extinction at certain intervals of the two sounds. Corresponding beats were obtained from two organ-pipes and two tuning-forks nearly in unison. One of these tuning-forks, mounted on its resonance case, being silent, the other, unmounted, was now struck, and its prongs brought near to, but not touching those of the first fork; at first no sound could be heard, but by degrees the unmounted fork transferred its motion to the mounted one, and the sound of the latter slowly welled forth. The sound of the voice can thus be transferred to the strings of a pianoforte, and in the same way a flame can be made to accept and resound to a note of the proper pitch. This was illustrated as follows:—A singing flame, by adjusting the paper slider, was tuned to the note of a certain fork; the tube was then raised slightly, so that the sound could be quenched by momentarily placing the finger on the top of the tube. On now striking the fork, and holding it over a resonant jar, the flame instantly started into song. The same effect was shown by the syren, and also by the human voice. Retreating to some distance from the flame, the latter could be made to respond at pleasure, by pitching the voice to the proper note, whilst it remained utterly unaffected by any note not in unison with itself. Musicians would find such a flame a faithful monitor in training the voices of their pupils.

In the last experiment we have really a *sensitive* flame; but this name is now applied to another discovery, which was made in the following manner:—Two years ago (December, 1865), whilst engaged in some acoustic experiments, the lecturer had observed that every time a shrill note was produced, a tall tapering gas flame in his vicinity was singularly affected; the flame shrinking every time the note was sounded. That observation led to further experiment and enquiry, the result of which has been the discovery of the conditions of success for obtaining flames sensitive to the slightest sound. Some months after the above observation, Professor Tyndall took up the subject, and having largely added to its interest and importance, offered an explanation of the phenomenon in a lecture delivered at the Royal Institution, in January, 1867. At this lecture the discovery was first published, and the name given to "Sensitive Flames." Subsequently the lecturer had proposed a fuller explanation, and had discovered that not only flames, but all gases could be rendered extremely sensitive to sound—the track of the gas being marked by mixing it with smoke.† This historical notice would be unjust without referring to an observation made ten years ago in America by Professor Leconte. That physicist had noticed that certain sustained sounds in an instrumental concert caused a very perceptible movement of the ordinary gas flames in the room. This observation is really the germ of the more wonderful effects afterwards independently discovered by the lecturer. Though Professor Leconte was the first to publish the fact, in 1858, it appears that, previous to this date, artisans had frequently noticed the phenomenon as resulting from the shrill sounds of their work; and several musicians have informed the lecturer that the same effect has been one they have commonly observed.

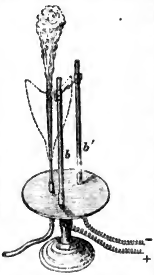
Turning now from scientific history to experiment, the lecturer showed various kinds and degrees of sensitive flames. First, a "batswing" flame, which, under the ordinary gas pressure, moved slightly at the sound of a whistle, but thrust out long tongues of fire when the pressure was increased by urging the gas from a holder. This increased pressure was always necessary to obtain the more sensitive flames, for a reason that will be understood directly. A jet of gas, issuing from a V-shaped orifice, was shown to be quite insensible to sound until the flame reached a height of 10 or 12 inches, and then, at the sound of certain high notes, the flame shortened and spread out into a fan-shape. Whistling to this flame in one key had no effect, while in another the effect was very marked. Playing an air upon a so-called bird-organ, the flame selected the high notes, and promptly shortened at their recurrence.

The probable cause of the sensitiveness of these flames was then alluded to. The impact of air evidently had nothing to do with the phenomenon. This was strikingly shown in the following experiment:—By tapping a membrane stretched over the mouth of a large tin funnel, a puff of air could be driven with such force from the narrow extremity that a candle was easily extinguished some 12 ft. away. Directing this puff of air against the sensitive flame, it was seen that the flame moved violently, but was utterly unaffected when the puff was driven either to the right or left. This should also be the case if in former experiments it were the impact of the air, and not the sound that produced the effect. But it was at once seen that when the lecturer whistled, at the same time slowly turning round, the flame still continued to shrink, and was almost as powerfully moved when the back was turned to the flame. The effect, then, is solely produced by the wave-like to and fro motion of the sonorous pulses. As first indicated by Professor Leconte, a gas flame, to be sensitive, has to be brought near its point of roaring; it then stands, according to Dr. Tyndall, as it were on the brink of a precipice, over which the sound pushes it. Agreeing with this explanation, that a sensitive flame is a body in a state of unstable equilibrium, the lecturer supplemented it by comparing the flame to a resonant jar; the flame, as was proved by a moving mirror, being in a state of rapid isochronous vibration when under the influence of external sound. The actual shrinking of the flame was due to an increase in the velocity of the current of gas, which was possibly brought about by an external sound throwing the pipe that conveys the gas into a state of vibration, which would thus narrow the channel of the gas passage: the change in the aspect of the flame being largely modified by the shape of the burner.

Whatever may be the complete explanation of the phenomenon, there can be no doubt that in a somewhat similar manner other objects besides flames are also sensitive to slight external impulses. Thus, many chemical compounds, as, for example, fulminating powders, are in a state of unstable equilibrium. The so-called "Rupert's Drop," which, when scratched, flew into a thousand fragments, is another instance of this kind; and some of the most eminent physicists are inclined to believe that the surface of our sun is in a somewhat analogous sensitive condition. From inorganic things we may travel on to organic, for we have evidence that there also exists in organised structures a more or less sensitive state at certain times. Thus, our wonderfully complex bodies, by disease or nervous derangement, are often thrown into an abnormal state, and when in that condition are sensitive to the slightest stimuli, if of the proper kind. This may possibly be the foundation for whatever truth there is in the science of homœopathy, the body being sensitive to a feeble influence, similar in kind to the disease under which it is suffering.

Here some may ask—"Of what good are these speculations, and to what practical end can these experiments be turned?" This observation, permit me to remark, is wholly improper. There is something nobler in life than the accumulation of wealth, and a higher end to experiment than its mere monetary value; for all accession to knowledge must finally benefit the world. This ever intrusive exclamation *cui bono* is a serious check to the advancement of knowledge, for it disheartens those who are making nature yield up her secrets, and it damps the ardour of every searcher after truth. Allow me to illustrate my meaning. Imagine that when enchanted by the performance of some well-executed opera or oratorio, a companion by our side were to say—"Well, after all, of what good are these fine sounds: to what practical end can you turn this music?" Should we not instantly condemn a speech so characteristic of a sordid and sensuous mind? And when the student of nature is listening with admiration and even awe to the sweet, though silent, music sung to him by every object of his diligent study—by air and water, by flowers and flames—he is conscious that he bows before an oratorio as far above that of Handel as the works of the Creator are superior to the composition of the creature.

Still, however, the lecturer was enabled to show a practical application of these sensitive flames. Attention was drawn to the fact, that the flame shortened and spread out laterally under the influence of a whistle. Advantage was taken of this peculiarity to construct an instrument which may be turned to some practical use. The instrument consists of two sliding brass rods, *b b'* (see diagram); attached at right angles, to the summit of one is a compound metallic ribbon, consisting of thin layers of silver, gold, and platinum, welded together. This arrangement expands unequally by heat, by so doing it swerves aside, and is thus brought into contact with a platinum point projecting from the top of the second brass rod, which is fixed about half an inch from the free extremity of the compound metallic ribbon. Connected with the two brass rods is an electric battery, associated with which is an electric bell, placed in a far distant part of the room. The bell will immediately ring if the electric circle be complete, but at present there is a gap in the circuit between the metallic ribbon and the platinum point. "I now ignite," said the lecturer, "a sensitive flame, which, in its ordinary state, burns at about 2 inches from the compound metal ribbon. I retreat some thirty feet from the flame, and whistle; the flame at once responds; it shrinks and spreads out sideways. By so doing it comes in contact with the metal ribbon; the latter instantly springs aside at the warm touch of the flame, strikes against the



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† *Philosophical Magazine*, March and April, 1867.

platinum point, completes the electric circuit, and there you hear that distant bell answering me every time I whistle." In the same way, at any hour of the night, the crying of a child in its cot would automatically announce itself in its parent's room. By a somewhat similar arrangement, using, however, a different burner, a burglar, filing the iron-cased doors of a jeweller's shop could be made to sound an alarm bell; and it is even possible, by making use of the propagation of sound through water, the reflection of that sound through a trumpet immersed in the water, and its conduction to a sensitive flame, shut out by non-conductors of sound from the noises on board ship, that an arrangement might be constructed by which the approach of a vessel in a fog might be detected by ringing a bell in the captain's cabin. It is not, however, my province to develope such inventions. With diffidence I throw out these suggestions, which may, I trust, by the practical mind be in some way turned to the public good.[*]

The lecturer had reserved for the conclusion a flame wonderfully sensitive to the slightest noise. The burner which gave this flame was formed of steatite, and consisted of a single circular orifice, through which the gas was forced from a large holder in the lecture-room, with greater pressure than could be obtained from the main. The flame was now fully 2 ft. in length, and observe, said the lecturer, how delicate and fragile a thing it appears to be; for at the slightest noise it drops down a foot.[‡] The jingling of this bunch of keys, the crumpling of this paper, the dropping of a small coin, are more than sufficient utterly to break up its height and symmetry. This flame makes no response to the vowels, O, U, nor to the labials, but it energetically responds to the sibilants. Repeating the stanza—

> "Roll on, O rill, for ever!
> Rest not, lest thy wavelets
> Sheen as shining silver—
> Shrink and sink to darkness."

The flame is unmoved by the first line, but emphatically bobs at the sound "rest" and "lest," and admirably suits its action to the words of the last line, for, when shrinking, the light of the flame almost disappears. So sensitive is this flame, that even a chirp made at the far end of the room brings it down more than a foot. Like a living being, the flame trembles and cowers down at a hiss—it crouches and shivers as if in agony at the crisping of this metal foil, though the sound is so faint as scarcely to be heard; it dances in tune to the waltz played by this musical box—and, finally, it beats time to the ticking of my watch. How wonderful are all these facts! And the more we know of them the more wonderful do they appear; for this astonishing change in the aspect of the flame is produced by an infinitesimal portion of those almost inaudible sound-waves, already enfeebled by their distance from the flame. Looking back on these, and innumerable other wonders revealed by physical science, and looking forward on that vast region which remains to be explored, do we not feel ourselves sinking to utter significance by contemplating the mysteries by which we are surrounded; whilst at the same time are we not conscious there is that within us still more wonderful than that without—a consciousness which lifts itself above all phenomena, grand and mysterious though they be?

EGG-ALBUMEN, FROM A CHEMICAL POINT OF VIEW.

By JOHN SPILLER, F.C.S.

On a recent occasion it has been proposed to employ the white of egg in a naturally moist condition as the standard of comparison in estimating the quality, or degree of impurity, of potable waters, as regards their nitrogenous organic constituents. Variations in the amount of nitrogen contained in the white of egg have, however, been admitted, and the proportion of water, or, in other words, the weight of dry albumen, is suspected to be subject to variation. Whilst engaged in some experiments upon this new method of water analysis, in which, as I have said, albumen is taken as the starting point, and its nitrogen (or a known fraction of it) is evolved and estimated in the form of ammonia, it appeared to me desirable at once to ascertain whether or not the moist contents of the egg lost water by evaporation through the calcareous shell; for if this be the case to any appreciable extent, the constitution of the albumen within cannot possibly remain for any length of time fixed and definite, although the egg itself may, during this period, be perfectly preserved from organic decomposition.

My affirmative anticipations on this point were based upon the circumstance that a new-laid egg exhibits no cavity on breaking the shell, whilst a stale one always contains a considerable air-space; however, to set the question at rest, I made the following experiments:—The weight of a hen's egg was exactly taken, and it was then supported upon a wire tripod-stand, so that the air might have free access to the whole external surface of the shell. Upon weighing the egg after an interval of twenty-four hours, it had lost exactly one grain, and this ratio of loss by evaporation remained tolerably constant during several days. As, however, the experiment was made in the winter time, and during a season of wet weather, I repeated it under somewhat modified conditions. Two new-laid eggs of large size were taken, and, after their weights had been accurately determined, they were supported in a similar manner within a bell-jar, resting on a flat glass plate, with a dish of concentrated sulphuric acid to absorb the water given out by the eggs. The whole arrangement (that is to say, the desiccator and its contents) was placed in a room the temperature of which was maintained pretty uniformly between 55° and 60° Fahr., and there left for six weeks, the diminution of weight being frequently observed during this interval. In all, ten weighings were taken, and the results proved that 100 gr., or more, of water can be abstracted under these circumstances, whilst the loss in the intermediate periods followed a diminishing scale, but nearly coincided with the several intervals of time. The average loss of water by evaporation through the shell may be stated, for the two eggs operated upon, to have been at the rate of 2 and 2½ gr. respectively per diem. Upon breaking the eggs at the end of six weeks, one was found perfectly sweet and good, with the envelope of the yolk unbroken, but the second and smaller one was discoloured next the shell, and the albumen had become slightly decomposed. The last results with this egg were consequently disregarded.

The details of the experiments are quoted, for they serve to show the proportion of yolk to white at the final stage; ratio of water evaporated to total liquid contents; and the exact weight, in each instance, of the shell with its lining membrane, after careful washing with dilute ammonia and subsequent drying in the air:—

Egg—No. 1.

Original weight (entire)	975·0	gr.
Loss of weight in six weeks (water) ..	100·0	,,
Shell and membrane	99·2	,,
Yolk..	317·2	,,
White (by difference)	458·8	,,

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[*] Several of the laws of acoustics may be illustrated to a large audience by means of the sensitive flame next to be described. Placing, for example, a watch in the focus of one concave mirror, and a sensitive flame in the focus of a distant second one, the reflection and convergence of sound is seen by the regular beating of the flame to every tick of the watch. The decay of sound, and the prevention of that decay by tubes, can also be shown in a similar way. Many other illustrations of acoustical phenomena at once suggest themselves. I hope shortly to publish some further applications of this novel *phonoscope*.—W. F. B.

[‡] It is easy to see how a modification of the instrument just described can be, and has been, applied to this flame. The diminution of heat arising from the falling of the flame can cause the compound ribbon now placed above the flame, to *recoil* upon the other battery connection: or, another arrangement may be employed, an air-thermometer having a bent stem, in which are sealed asunder platinum terminals; the circuit being closed by the backward movement of mercury in the tube, owing to the contraction of the air in the bulb.

Egg—No. 2.

Original weight (entire)	930·6	gr.
Loss of weight in three weeks (water)	41·6	,,
Shell and membrane	85·2	,,
Yolk and white	803·8	,,

It will here be noticed as an anomaly that the heavier shell of No. 1 egg permitted a faster rate of evaporation through its substance than No. 2. The latter appeared, however, upon inspection, to have a smoother external surface, and to be stronger and more compact in structure throughout.

The following table shows the actual amount of water lost by evaporation in the two instances for the intervals of time specified in the first column:—

Loss of Weight in Desiccator (Water evaporated).

Intervals of time. Days.	No. 1 Egg. Gr.	No. 2 Egg. Gr.
1	3·4	2·6
2	6·9	4·7
7	17·3	14·0
14	34·3	27·6
21	51·1	41·6
42	100·0	—

Ratio of Water Evaporated to Total Liquid Contents of the Egg (per cent).

Time.	No. 1.	No. 2.
In two weeks	3·9	3·3
three ,,	5·8	4·9
six ,,	11·4	—

It would be difficult to prove whether or not the water lost by evaporation from the white is partly compensated by an accession of water, by diffusion, from the yolk. No colouring matter travels outwards unless an organic decomposition sets in, when all the natural barriers are destroyed, and the several parts of the egg become merged. I am inclined to think that this re-distribution of water actually occurs, since the *sac* of the yolk appears wrinkled in a stale egg, as though by loss of a portion of its liquid contents.

The composition of fresh egg-albumen may be said to vary between the following limits:—

Water	88 to 85 per cent.
Dry albumen (containing nitrogen 1·55 to 1·75 per cent)	12 to 15 ,,

Other analyses have been recently published, in which the nitrogen amounts to 1·81 per cent and upwards, with the minimum proportion of water. It is probable that these latter results were obtained with eggs which had been longer kept in stock.—*The Photographic News.*

RELATIVE VALUES OF FRENCH AND ENGLISH WEIGHTS AND MEASURES.

By A. A. FESQUET.

I see in the column of Notes and Queries (American reprint, March, 1868) that one of your readers wishes some calculations showing the relative value of French and English weights and measures. Tables for this purpose are to be found in many technical works, but I think they are not so complete as those I join to this letter. You will see by the number of different values of the gramme, and of the carat weight, that "the doctors or the standards disagree."

The value I have adopted for the gramme is 15·438395 troy grains, calculated from 1 pound avoirdupois = 7000 grains = 453·4148 grammes.

It may be that these data, or my calculation, are incorrect; if so, I wish to be corrected. It would be a satisfaction to many of your readers to know the exact value in grammes of the English standard pound avoirdupois, and how many troy grains it contains. Most authors say 7000 grains; however, I have seen 7004 grains printed somewhere.

The use of the metric system is extending more and more; but the abbreviations in writing are not always short and corresponding to the simplicity of the system, therefore I have added to the tables a series of symbols for abbreviations, which will be understood by looking at them. This system is based on the same principles followed in chemical symbols. Each unit and its prefixes are indicated by their first letter, with this difference, that a capital letter is used when the prefixes are those increasing the unit.

We use already: kgm. = kilogrammetre; we might have as well, kg°. = kilogramme degree, g = gramme, instead of gm. or grm.

Philadelphia, March 23rd, 1868.

TABLES

SHOWING THE RELATIVE VALUES OF FRENCH AND ENGLISH WEIGHTS AND MEASURES, &c.

Measures of Length.

Millimetre	=	0·03937	inch
Centimetre	,,	0·393708	,,
Decimetre	,,	3·937079	inches
Metre	,,	39·37079	,,
,,	,,	3·2808992	feet
,,	,,	1·093633	yard
Decametre	,,	32·808992	feet
Hectometre	,,	328·08992	,,
Kilometre	,,	3280·8992	,,
,,	,,	1093·633	yards
Myriametre	,,	10936·33	,,
,,	,,	6·2138	miles

Inch ($\frac{1}{36}$th yard)	=	2·539954	centimetres
Foot ($\frac{1}{3}$rd yard)	,,	3·0479449	decimetres
Yard	,,	0·91438348	metre
Fathom (2 yards)	,,	1·82876696	,,
Pole, or Perch (5½ yards)	,,	5·02911	,,
Furlong (220 yards)	,,	201·16437	,,
Mile (1760 yards)	,,	1609.3149	,,
Nautical mile	,,	1852	,,

Superficial Measures.

Square millimetre	=	$\frac{1}{645}$th of a square inch		
,, ,, ...	,,	0·00155	,,	,,
,, centimetre	,,	0·155086	,,	,,
,, decimetre	,,	15·5086	,,	inches
,, ,, ...	,,	0·10769	,,	foot
,, metre or centiare	,,	1550·86	,,	inches
,, ,,	,,	10·7698	,,	feet
,, ,,	,,	1·196033	,,	yard
Are	,,	1076·98	,,	feet
,, ...	,,	119·6033	,,	yards
,, ...	,,	0·098845		rood
Hectare	,,	11960·33	,,	yards
,, ...	,,	2·471143		acres
Square inch	,,	645·109201	sq.	millimetres
,, ,, ...	,,	6·45109	,,	centimetres
,, foot	,,	9·2903	,,	decimetres
,, yard	,,	0·836097	,,	metre
,, rod or perch ..	,,	25·291939	,,	metres
Rood (1210 sq. yards) ..	,,	10·116775		ares
Acre (4840 ,, ,,) ..	,,	0·404671		hectare

Measures of Capacity.

Cubic millimetre	=	0·000061029	cubic inch
„ centimetre, or millilitre	„	0·061029	„ „
10 cubic centimetres, or centliitre ..	„	0·61029	„ „
100 „ centimetres, or decilitre ..	„	6·10295	„ inches
1000 „ centimetres, or litre	„	61·0295688	„ „
„ „ „ ..	„	1·760773	imperial pint
„ „ „ ..	„	0·2200967	„ gallon
Decalitre	„	610·295688	cubic inches
„	„	2·2009668	imp. gallons
Hectolitre	„	3·5317	cubic feet
„	„	22·009668	imp. gallons
Cubic metre, or stere, or kilolitre	„	1·308	cubic yard
„ „ „ ..	„	35·3171	„ feet
Myrialitre	„	353·171	„ „

Cubic inch	=	16·3855	cubic centimetres
„ foot	„	28·3159	„ decimetres
„ yard	„	0·764520696	„ metre

American Measures.

Winchester, or U.S. gallon (231 cub. in.)	=	3·785085	litres
„ „ bushel (2150·42 „)	„	35·23603	„
Chaldron .. .. (57·25 cub. feet)	„	1621·085	„

British Imperial Measures.

Pint (⅛ gallon) ..	=	0·567932	litre
Quart (¼ „) ..	„	1·135864	„
Imperial gallon ..	„	4·54345797	litres
Peck (2 gallons) ..	„	9·0869159	„
Bushel (8 gallons)	„	36·347664	„
Sack (3 bushels) ..	„	1·09043	hectolitre
Quarter (8 bushels)	„	2·907813	hectolitres
Chaldron (12 sacks)	„	13·08516	„

PETROLEUM FUEL FOR STEAM SHIPS.

The considerations which should govern the discussion of the question of the substitution of petroleum in place of coal for the generation of steam may be classed under the following heads:—First, the comparative heating or steam-producing capacity of the two substances, weight for weight; second, the comparative cost, weight for weight; third, the comparative cost of of attendance in the fire or boiler-room; fourth, the cost and durability of the apparatus necessary for burning the petroleum (under this head, with the retort system, the air-pumps for forcing air into the retort, and, if it is not by gravity, the pumps for forcing in the petroleum should be included); fifth, the comparative difficulties encountered and space required in stowing the two fuels.

With respect to the comparative heating power of anthracite coal and petroleum, let us first mention their absolute theoretical steam-generating capacities; that is, if the combustible elements in both cases could be completely consumed, and all the heat thus generated be utilised in making steam. According to the accurate and elaborate experiments of the eminent chemists, MM. Favre and Silberman, a pound of carbon completely burned, so as to make carbonic acid (that is, by combining with 2⅔ lbs. of oxygen), will evaporate 15 lbs. of water from a temperature of 212° Fahr.; and similarly, 1 lb. of hydrogen, by combining with 8 lbs. of oxygen, will evaporate 64·2 lbs. of water from the same temperature. The chemical composition of petroleum is said to be $C_{12}H_{12}$; or, in other words, it is composed of 12 atoms of carbon and 12 atoms of hydrogen. As an atom of carbon exceeds an atom of hydrogen six times in weight, it is seen that in a pound of petroleum 6 parts are carbon and 1 part hydrogen. The absolute theoretical evaporative power of a pound of petroleum, in pounds of water, from 212°, is therefore $\frac{6}{7} \times 15 + \frac{1}{7} \times 64{\cdot}2 = 22{\cdot}02$ lbs. Allowing that there is 20 per cent of non-combustible matter in anthracite coal, there remains in a pound $\frac{4}{5}$ of a pound of carbon; hence $\frac{4}{5} \times 15 = 12$ lbs., the weight of water that theoretically may be evaporated from 212° by a pound of anthracite, under these conditions. Consequently, the absolute heating power of petroleum is 1·835 times greater than that of a pound of anthracite.

Now let us look at the comparative cost: the average price of crude petroleum is about 21 cents per gallon, and coal about 5 dollars per ton; in other words, the petroleum costs 3 cents per lb., while the cost of the coal is ·23 of 1 cent. Hence, a pound of petroleum, while it has but 1·835 times more absolute heating power than a pound of anthracite, costs 13 times more than the coal; that is, the heat produced by petroleum costs over seven times more than the heat produced by coal. The greater cost of the petroleum is therefore decisive against its economical use as a steam fuel, and this, too, without considering the complication of the apparatus necessary for burning it. With regard to the comparative cost of the attendance on the fire, economy in this particular is decidedly in favour of the petroleum. It is probable that a steam vessel which requires, say 24 men in the fire-room, could dispense with at least 14 of them by the use of petroleum.

So far, we have assumed that not only was all the heat generated that is attainable from the perfect combustion of the two fuels, but that the whole of this heat was utilised in the evaporation of water. It need scarcely be remarked that such results are quite out of the question in practice. The experiments carried on with the machinery of the U. S. gun-boat, *Palos*, in Boston harbour, throw much light on the evaporative power practically attainable with the two fuels. The petroleum in these experiments was burned by the contrivance known as Foote's retort apparatus, and the result of these trials was, that if the evaporative power of the anthracite is represented by 1, that of the petroleum is 1·38—a result much inferior to that which we have shown is due to the combustible elements of the two substances. This, perhaps, is due to the fact that it is more difficult to completely burn a hydrocarbon fuel than it is to burn one composed almost wholly of carbon. If we modify the calculations we have before entered into, according to the results attained with the experiments on the *Palos*, conducted under the immediate supervision of the petroleum retort inventor, it will be seen that the result is still further against the economical use of the oil as a steam fuel.

We have now to consider the cost and durability of the apparatus for burning the oil. As to the cost, let us look at the expense of applying the retort system to vessels of the *Wampanoag* class, which have 58 furnaces in their boilers. It is estimated that such an apparatus would cost at least 250 dollars for each furnace, or 250 × 58 = 14,500 dollars, and when to this is added the cost of the air-pumps for pumping air into the retort, the engines for driving them, together with the pumps for forcing the petroleum into the retorts, and the paraphernalia of cocks, valves, and pipes connected with this machinery, we think it is safe to assume that the application of the retort system to such a ship would cost at least 60,000 dollars. When we come to look at the durability of this apparatus, the case is still more strongly against the petroleum; and when the high temperature to which the apparatus is exposed is considered, it becomes evident that portions of it will require constant renewal. But the most fatal practical objection to the retort system remains to be mentioned: it is the deposition of carbon, coke, and incombustible matter within the retorts and pipes. In experiments with a retort apparatus, the pipes and passages became so choked in less than 48 hours that the fire went out, and could only be renewed by taking the fixture apart and cleaning it.

With regard to storing petroleum on board ship, another serious difficulty is encountered. A great portion of the crude oil evolves, at ordinary temperatures, an inflammable gas; and this gas, when mixed with atmospheric air, forms an explosive compound, which instantly takes fire when brought in contact with flame. Other samples do not evolve this gas until the temperature is raised from 80° to 100° Fahr.

These facts point out at once the extraordinary care that must be taken in storing this substance on board ship, in order to guard against accidents of the most frightful character. It therefore seems clear that a proper regard for safety demands that the tanks containing the petroleum should be immersed in water; when the weight of these tanks and cisterns is borne in mind, together with the bulk of petroleum and coal composition (a cubic foot of the former weighs 50 lbs., and a cubic foot of anthracite, as stored in bunkers, weighs 52·5 lbs.), and also their relative heating values, which may be set down as 1·4 for the former and 1 for the latter, it may be with safety assumed that there would be a saving in weight and space of not over 30 per cent in stowage capacity by substituting the oil for the coal. It is therefore evident, from what we have said, that even assuming that the oil and the coal can be burned with equal facility, and with an equal degree of liability to derangement, in steam-boiler furnaces, the excess of the heating power of the petroleum over that of the oil is so very much less than its excess of cost, that there is not the slightest probability, as long as these ratios exist, of petroleum ever taking the place of coal as a steam fuel.

When we look at the great complication and danger that must be added to steam machinery in order to burn the oil, and the liability to derangement and the want of durability, it is not likely that any prudent steam navigation company would allow it to be employed in their vessels, even if they could find an engineer to recommend it.—*American Artisan.*

PROCEEDINGS OF SOCIETIES.

PHILOSOPHICAL SOCIETY OF GLASGOW.

Ordinary Meeting, April 29th, 1868.

Dr. F. H. Thompson, President, in the Chair.

Amongst the papers read at this meeting, there was one "*On the Sources of Sulphur used in the Manufacture of Oil of Vitriol or Sulphuric Acid,*" by Mr. James Mactear, F.C.S., of the alkali department, St. Rollox Chemical Works. After making some few preliminary remarks,

Mr. Mactear proceeded to say that the quantity of oil of vitriol manufactured in this country exceeds 500,000 tons per annum, and of this quantity about 320,000 tons are used in the conversion of common salt into sulphate of soda, for the production of alkali by Leblanc's process, the remainder being taken up chiefly in the manufacture of artificial manures. The sulphur consumed last year, in making oil of vitriol, amounted to 160,000 tons, but of this quantity only from 10,000 to 20,000 tons consisted of brimstone; the remainder is obtained from pyrites, of which upwards of 375,000 tons were burned. The brimstone is used chiefly in the manufacture of "sale acid," and this again is used mostly for bleaching purposes which require a very pure acid, that made from pyrites being always more or less contaminated with arsenic and other impurities of a detrimental character.

Since the year 1851 the price of brimstone has been very high, owing to the great quantity of sulphur required in the treatment of the vine disease.

Up to the year 1856 all the pyrites used was obtained from Cornwall and Ireland, except a small quantity of "coal brasses" found in the coal-fields. In that year some cargoes of Spanish pyrites, containing a small percentage of copper, were imported and used by the Tyne manufacturers, who liked the ore very much, on account of the high percentage of sulphur which it contained; while it is burned at as low a cost per ton as the ore of low strength. At least one half of the ore now used is Spanish cupriferous pyrites. The author illustrated the economy of working pyrites by stating that Irish ore contains about 35 per cent of sulphur, while Spanish ore contains as much as from 45 to 50 per cent; and, assuming that the cost of burning in both cases is 2s. per ton, in the one case 35 parts, and in the other from 45 to 50, are burned off for the same amount. But it is found that the refuse contains, in both cases, about 5 per cent of sulphur on the average, so that there is actually burned off 86 per cent of the sulphur of the Irish ore, and 89 per cent of that contained in Spanish ore of 45 per cent strength, thus giving a clear gain of 3 per cent.

Mr. Mactear then referred to certain disadvantages attending the use of pyrites instead of Sicilian sulphur:—

First. A greater amount of chamber space is required for burning pyrites than for sulphur. This is usually taken to be in the ratio of 45 to 30, and is due to the fact that the iron of the ore is peroxidised during combustion, and therefore uses extra oxygen and nitrogen (which passes on unchanged); and for the extra amount of both of these gases chamber space must be provided.

Second. The arrangements for burning pyrites are much more costly than for burning sulphur; the heat is greater, and therefore there is more wear and tear of the chambers and connecting-pipes.

Third. There is always a larger percentage of nitre required with pyrites than with brimstone.

Fourth. Owing to various causes, the acid produced is of inferior quality.

Fifth. It involves more labour to work pyrites than to work brimstone; and there is a large amount of refuse—approximately three-fourths of the weight of the raw ore—for which room has to be provided.

Sixth. In burning pyrites, and during transit, much *small* is made, and this cannot be burned properly unless in a separate furnace. The most common form is a muffle furnace; in it the "smalls" are roasted, with free admission of air, but the quantity passed into the chamber is so great, in proportion to the sulphur, that this method is objectionable.

Taking all these disadvantages into account, it is found that, in making ordinary sulphuric acid, 1 ton of sulphur, in the form of pyrites, costs only £4 10s., while Sicilian sulphur costs from £6 to £7. The ore is usually sold at so much per cent of sulphur per ton; for some years the rate was 1s. per unit, at present it is 8d.

Theoretically, 100 parts of pure sulphur should yield 306·25 parts of oil of vitriol, and in practice it is found that 100 parts of brimstone, containing 1 per cent of impurity, can be made to yield 302 parts of acid, while with pyrites the acid produced only amounts to 285 parts of the sulphur actually burned, or 275 parts on the sulphur actually present in the ore.

The author then referred in detail to the several sources from which the required sulphur is obtained. He spoke of them in the following order, and illustrated his remarks by a very extensive collection of specimens:—

Sicilian Sulphur.—This is found chiefly in the volcanic districts on the south coast of Sicily, more or less pure, and imbedded in lime and clay marl. It is extracted from the crude mineral in various ways, according to the richness of the material. If the mineral is very rich, it is simply melted in a cast-iron pot, and then the liquid sulphur is ladled out into moulds; but if the mineral is poor in sulphur—some kinds containing only 15 to 20 per cent—it is distilled in earthen retorts, and usually condensed in water. As imported into this country it consists of three qualities—"firsts," "seconds," and "thirds." The latter only is used in making oil of vitriol, the others are refined for making gunpowder.

Spanish Pyrites.—In the author's opinion, this mineral claims the first attention, owing to its forming at least one half of all the pyrites burnt in the sulphuric acid manufacture. It is found chiefly in the province of Huelva; the deposits pass, however, from Spain into the adjoining part of Portugal. Some of the deposits are nearly a mile long, of great depth, and of varying width. Till lately, the great bulk of pyrites imported was brought chiefly from Mr. Mason's mines, near the river Gaudiana. The owner was the first person to construct a railway as a means of transport from the mines to the coast, instead of the antiquated and expensive method of mule carriage. Mules are still employed at all the other mines, and the mineral is carried in sacks or baskets on the mules' backs. A few years since, the Tharsis Mining Company, consisting chiefly of Glasgow capitalists, was formed to purchase and work a number of mines. The pyrites from the Tharsis mines are now used largely, and the imports of Mr. Mason's ore have been much reduced. The latter usually contains about 50 per cent of sulphur, besides 3 or 4 per cent of copper. The Tharsis mineral contains 48 to 50 per cent of sulphur, and 4 to 5 per cent of copper. Both kinds are much the same in their working qualities; they burn well, and make comparatively little dust in breaking.

Norwegian Pyrites.—Many mines of pyrites occur in Norway, but those in the vicinity of Drontheim are the most important. The Norwegian ore is pretty largely imported into this country, but chiefly to the Tyne. The largest quantity is raised in the mines Ytterien, the annual product being from 6,000 to 8,000 tons. It consists of very small crystals, is of good quality, burns well, and does not slag in the kilns. It contains about 44 per cent of sulphur, and from 1 to 2 per cent of copper. Under this head Mr. Mactear referred to a second quality of this mineral; to an excellent variety obtained about 30 miles from Drontheim, and containing but a trace of copper; to the ores obtained from some mines opened lately near Bergen; and to another variety which comes from Nordland, yielding 42 per cent of sulphur.

Swedish Pyrites.—This is obtained in mining for copper ores, and is said to exist in enormous quantities, but at present the want of means of cheap transport to convenient shipping prevents it coming into extensive use. A few cargoes, however, have found their way to Britain, and the ore itself has been found to work.

Belgian Pyrites.—Large quantities of this ore are imported, especially to the Tyne—the freight from Antwerp being very low, sometimes only 6d. per ton. The mines yielding it are in the districts of Liege and Namur, and are worked primarily for lead and zinc ores. One kind is called alluvial pyrites, and has the form of coprolites, and few of the pieces weigh more than a pound each. It burns well if used along with Norwegian or other ores. Another resembles a slag or cinder, and often contains lead or antimony. Belgian ores contain from 40 to 50 per cent of sulphur, and traces of thallium.

Westphalian Pyrites.—This resembles a very poor fireclay, or shale, in appearance, but it burns well. It is said to contain a considerable quantity of thallium. The analysis gives 42 to 45 per cent of sulphur.

Italian Pyrites.—Very little of this is imported, for although it contains about 45 per cent of sulphur, it also contains 9 or 10 per cent of silica, and its physical properties are not in its favour.

Irish Pyrites.—This is obtained from the Wicklow mines, where it occurs in beds of great thickness. It contains from 30 to 35 per cent of sulphur. A deposit occurs in the Vale of Avoca which contains about 44 per cent of sulphur.

Cornish Pyrites.—Under this head the author included the ore from the mining districts of Dorset, Devon, and Cornwall. It is got in the dressing of the lead and copper ores, and usually contains from 25 to 30 per cent of sulphur and 1 or 2 per cent of copper, and frequently arsenic. The author also referred to the fact that Mr. Vivian is making sulphuric acid by burning copper pyrites in kilns of peculiar construction.

Coal Brasses.—This material, also called "Scotch gold," is largely used, and is a cheap source of sulphur for acid to be used in making manures, &c. Even when well cleaned it always contains organic matter, and possesses other disadvantages; still it is useful in keeping up heat in the kilns if used along with other varieties.

Cleveland Pyrites.—Although interesting to the geologist, this mineral is of little interest to chemical manufacturers, and the author said he only knew of one establishment where it is used—one near Middlesbro'-on-Tees.

The author concluded his paper by referring to the sulphur-recovery process, patented by M. Mond, and now being practically applied under his (the author's) care at St. Rollox Chemical Works.

Several members of the Society spoke on topics suggested by the paper; and a vote of thanks was passed to Mr. Mactear.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, March 13, 1868.

"*On the Probable Exhaustion of our Coal Mines,*" by W. Stanley Jevons, M.A., Professor and Cobden Lecturer on Political Economy in Owens College, Manchester.

I. The coal raised from the coal mines of the United Kingdom in the year 1866 amounted to more than *one hundred million tons* (more exactly 101,630,544 tons), according to the excellent returns published by Mr. Robert Hunt, of the Mining Record Office. Reflecting upon the full significance of this fact it may be asserted:—

1. That the coal trade of this kingdom is the greatest trade, in regard to the bulk and weight of the commodity, ever carried on.

2. That every pound of that vast quantity of coal may be regarded as a pound of the most intrinsically useful and valuable substance ever discovered.

3. That the power and usefulness of coal is felt in every branch of industry, and in almost every operation which we carry on.

4. That Britain possesses the aid of this most invaluable substance in an altogether peculiar degree: and—

5. That we cannot hope to stand very long in this most happy position.

II. So vast a quantity as 100,000,000 tons cannot be represented to the eye or mind. Its bulk is 30 times as great as that of the greatest single work of human hands, the Pyramid of Cheops. Greater quantities of commodities are brought into British ports at present, than are recorded in the history of any nation, and yet it would take more than seven times as many vessels as those which enter our ports in a year to carry the quantity of coal we use.

More than half of the whole carrying power of the railways of the United Kingdom, devoted to goods traffic, is occupied in the conveyance of coal. So far as we can judge from returns, which do not always distinguish the kind of goods carried, the goods traffic of the railways of the United Kingdom in 1865 was as follows:—

	Tons.
General Merchandise*	36,800,000
Minerals	18,300,000
Total.. ..	55,100,000
Coal and Coke	59,500,000
Total.. ..	114,500,000

III. This vast trade in coal can only be accounted for by considering the wonderful qualities with which coal is endowed. It is the mainspring of our material industry. It may be called the real Philosopher's Stone, which supplies us cheaply and plentifully with everything that can conduce to the service of man. This extreme usefulness of coal is due—

1. To the enormous power which is latent in it, and is brought forth when we burn it;

2. To the fact, now so clearly revealed by science, that *force is the key to all the changes of matter.*

By aid of the mechanical equivalent of heat, we can ascertain that good coal contains latent force sufficient to raise its own weight 11,422,000 feet, or about 2100 miles against the force of gravity. The coal raised in 1866 may further be calculated to contain force equal to that which would be exerted by 530,000,000 horses, or 2,650,000,000 men, working eight hours a day for 300 working days in the year.

IV. This vast power is turned to use in an indefinite multitude of ways, which may thus be rudely classified.

CLASSIFICATION OF THE USES OF COAL.

(I.) As Source of Heat.

1. *For Household Use.*—Warming and ventilating houses, churches, public buildings, &c.
2. *For the Alteration of Cohesive Condition of Substances.*—Melting and casting of metals; softening and forging of metals—the blacksmith's fire.
Manufacture of glass, bricks, earthenware, &c.
Boiling salt, soap, &c.; brewing, distilling: drying substances.
Chemical manufactures.
3. *For the Production of Power by the Steam, Gas, or Hot-air Engine.* Pumping water; draining mines; supply of water; removal of sewage.
Steam navigation.
Railways, and road locomotives.
Hammering, rolling, and working metals.
Mill and factory labour.
Hydraulic and pneumatic machines.
Small machines moved by gas engine.
Machine agriculture; steam ploughing, &c.
Manufacture of ice.

(II.) As Reducing agent; Source of Heat, with Chemical Affinity.

Smelting of the metals—iron, copper, lead, zinc, &c.
Chemical manufactures.

(III.) As indirect Source of Electricity by Magneto-Electric Machines.

Electro-telegraphy.
Electro-metallurgy.

(IV.) As Source of Light.

Gas manufacture; petroleum; paraffin candles.
Electric light-house illumination.
Photography by artificial light.

(V.) As Source of Material.

Tar, pitch, naphtha, lubricating oils.
Ammoniacal manures: carbolic acid; aniline dyes; ethereal odours and flavours, &c.

It is only by thus collecting together the multitudinous uses of coal that we can gain an adequate idea of its importance to us and the certainty that its use will extend.

V. Comparing, now, the present yield of coal (100,000,000 tons annually) with the quantity which Mr. Hull believes to lie in these islands, within 4000 feet of the surface and in workable condition (83,544,000,000 tons), we find that we might continue to consume coal at our present annual rate for 835 years at least; but when we remember that our consumption has increased by 36 millions in the last twelve years (from about 65 millions in 1854 to 101,000,000 in 1866), and that the causes of increase still continue in existence, we cannot attribute any importance to the above calculation. There is no appearance that steam navigation or railways have at all approached their full developement in this country; while in the steam plough, in schemes of steam-drainage or water-supply, the employment of steam-produced hydraulic pressure, in the use of small gas-engines in workshops, and in a multitude of other ways, we have some indication of the increased future demand for coal.

VI. Economy, it may be pointed out, does not tend to reduce the industrial consumption of coal, but acts in the opposite direction: by increasing the profitableness of coal-labour, it extends its use. Almost every improvement in the engine for the last century and a half has been directed to economising the consumption of coal; and yet the use of the engine and the quantities of coal consumed advanced *pari passu* with its economical performance.

It is altogether irrational to argue that progressive economy, which has coexisted with and been the partial cause of advancing consumption in the past, will have the opposite effect in the future.

VII. As regards the law of increase of coal consumption, both experience and theory lead us to believe that the increase takes place in a geometrical series, by multiplication rather than by mere addition. The following numbers will illustrate the difference in question:—

Arithmetical Series, increasing by addition ..	1	2	3	4	5	6	7	8
Geometrical Series, increasing by multiplication	1	2	4	8	16	32	64	128

The following table will show that when we can get accurate statistics of the consumption of coal we find the increments indefinitely increasing, in the manner rather of a geometrical than of an arithmetical series.

Year.	Total quantity of coal imported into London. Tons.	Increase in fifty years. Tons.
1650	216,000	—
1700	428,100	212,100
1750	688,700	260,600
1800	1,099,000	410,300
1850	3,638,883	2,539,883
1863	5,119,887	5,696,170[*]

The above and other statistics quoted in the 'Coal Question,'[†] Chapters IX. X. and XI. show that our industry grows by multiplication, and by multiplication at a rising rather than at a falling rate. The temporary depressions of trade which occur at intervals may sometimes seem to check the rapidity of this increase; but we have only to wait a year or two to see our industry advancing again with growing strides.

(To be continued.)

Solubility of Silicic Acid in Ammonia.—Richard Pribram has investigated this behaviour and found that SiO_3 is taken up by ammonia in the following proportions: natural anhydrous requires 6000, artificial anhydrous 260, hydrated dried 330, gelatinous 140 parts liquor ammoniæ of 10 per cent. Exposed to the air NH_3 evaporates, and finally a clear solution of $NH_4O,4SiO_3$ remains. By boiling, about 19-20ths of the remaining ammonia is expelled, and the clear solution contains about 80 of SiO_3 to one NH_3. Dried at ordinary temperature the residue has about the same composition, but water takes up mere traces of it. The results give a hint of the manner in which silica may be administered internally, and how plants most likely take up this compound.—(*Wittst. Viertelj.*, 1867, 30—41).

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[*] Not including live stock, of which the weight is not ascertained.

[*] Increase as for fifty years, if continued at same rate as during the thirteen years experienced.

[†] "The Coal Question: an Inquiry concerning the Progress of the Nation, and the Probable Exhaustion of our Coal Mines." By W. S. Jevons, M.A. 2nd ed. revised. London, 1866. (Macmillan.)

FOREIGN SCIENCE.

Paris, May 6, 1868.

Reduction of phosphide of iron minerals.—Prisms of constant deviation.

Considering the extent of the iron manufacture in England, the abundance of phosphoric iron ores, and the prejudicial influence exerted by phosphorus upon iron, M. Caron's research on the reduction of phosphide of iron minerals deserves space in these columns, if not, which we are far from saying, from its own intrinsic merit. To this savant we are already indebted for a former research upon the metallurgy of iron; he then showed that the addition of oxide of manganese to the blast-furnace charge eliminated a considerable part of the sulphur and silicium which passed into the slag. Since then he has observed that this oxide (oxide of manganese) while acting energetically in the expulsion of silicium and sulphur, is powerless with regard to phosphorus. Many sterile experiments were made, but one method gave, under certain circumstances, appreciable and satisfactory results. In the majority of cases, the phosphatic minerals worked for iron contain the phosphorus in the state of phosphate of iron, alumina, or lime; to counteract the pernicious influence of phosphoric acid, it has been customary to mix these minerals with lime, which alone, up to the present, has appeared able to separate the phosphorus from the iron. Unfortunately these phosphates mixed with lime are almost infusible, and a large proportion of silica is therefore obliged to be added to render the slag sufficiently fluid. M. Caron inquires, What passes under these circumstances? Three substances are found together, phosphates, silica, and carbon, exactly as in the process indicated by M. Wöhler for the preparation of phosphorus: there is on the one side a siliceous slag, on the other iron, carbon, and free phosphorus, which naturally enters into combination, and forms a phosphoric iron. This reaction, M. Caron maintains, is undoubtedly that which takes place, for analysis shows the slags of the blast furnace, operating with phosphatic minerals, to be free from phosphorus, while the resulting iron seldom contains an inoffensive amount of this element. Admitting that lime removes the phosphoric acid from the oxide of iron, evidently what is required is a flux other than silica, capable of dissolving phosphate of lime without decomposing it. Fluoride of calcium has appeared *à priori* best able to fulfil these conditions. Kryolite and other fluorides would doubtless produce the same effects. A mixture of phosphate of lime and fluoride of calcium was placed in a crucible of gas-retort carbon, covered externally with wood charcoal, and enclosed in an earthern crucible; a mixture of phosphate of lime and silica was placed in the same conditions. Thus prepared the two crucibles were heated to the temperature of the fusion of steel. The carbon crucible containing the silica and the phosphate was completely pierced; there remained the melted silicate of lime, but the phosphorus had disappeared. The crucible containing the fluoride of calcium was intact, a slight bed had been eaten in, probably due to the presence of a little silica; the button was phosphoric, and became luminous under the blow of a hammer. It was then certain that fluoride of calcium could dissolve phosphate of lime without occasioning any decomposition. Experiments were therefore made upon phosphate of iron. (1.) A mixture of suitable quantities of pure phosphate of iron, lime, and fluoride of calcium was placed in a brass crucible. (2.) A mixture of pure phosphate of iron, lime, and silica, was placed in a similar crucible. The two crucibles were heated to the temperature of the fusion of steel. The crucible containing the silica was eaten into, and the button of iron, crystallised in large plates, broke with great ease. The crucible containing the fluoride, on the contrary, was scarcely attacked; the metallic button slightly flattened under the hammer, and finally broke, yielding a granular fracture. The first button contained three times the amount of phosphorus present in the second. When operating upon phosphatic minerals containing less phosphorus than pure phosphate of iron, a sensible improvement follows the substitution of fluoride of calcium for silica; nevertheless the improvement becomes less and less important as the quantity of phosphorus in the ore decreases. Other compounds besides the phosphates are soluble in fused fluoride of calcium without decomposition: sulphates, arseniates, &c., behave quite similarly; alumina and analogous substances dissolve in this flux, and can thus be removed in the slag; otherwise the intervention of silica would be necessary.

M. Bauernfeind has published in the *Comptes Rendus* of the Academy of Sciences of Munich some interesting facts with regard to a prism which deviates the incident ray by a constant quantity, whatever be the angle of incidence. This result is obtained by two interior reflections; it is, however, necessary that the first refraction angle of the prism be double that of the second. Designate by A, B, C, the three angles of the prism, and by *a*, *b*, *c*, the three opposite faces; the ray enters at the face *a*, it is reflected internally first on *b*, then on *c*, and passes out at the face *b*. For the deviation to be constant it is necessary that $C = 2A$. A prism satisfying this condition deviates the incident ray by a quantity equal to the first refraction angle C, and the angle of emergence is always equal to the angle of incidence. The intensity may be augmented by silvering the reflecting surfaces. If the edge B be cut in such way as to make a fourth face parallel to *b*, an object in the direction of the deviated ray may be seen through the two parallel faces. When $C = 120°$ and $A = 60°$, the angle B becomes zero, and the face *a* parallel to *c*.

A rectangular prism, in which $C = 90°$, $A = B = 45°$, was employed by M. Bauernfeind some years ago in the construction of certain surveying instruments. In an apparatus with crossed prisms, the two prisms being symmetrically superposed, one was enabled to sight at the same time two points situated on the right and left of the observer, and to determine thus a point of the straight line which would join them.

CORRESPONDENCE.

PROFESSOR GUTHRIE'S VOLTASTAT AND GRAPHIC FORMULÆ.

To the Editor of the Chemical News.

Sir,—The report which appears in your No. 438 of the meeting of the Chemical Society of the 16th of April is full, and in the main so accurate, that to those of your readers who were present on the occasion it might serve as a record.

As, however, you address a larger public, I beg you to allow me as concisely as possible, to clear away some misconceptions which seem to have arisen at the time, and which, judging from your correspondent "F.C.S." in the above number have not been dissipated by reflection.

With regard to my voltastat, I have only two things to add to your report. The first concerns the use of the instrument as a voltameter. In order to calibrate the apparatus in the sense of determining the height of the mercury in the manometer tube, which corresponds to a given rate of gas delivery (or *vice versâ*), it is necessary to collect the gases evolved. But, when this is once done, the height of the mercury in the manometer shows at once the activity of the battery. And here I think the instrument is of considerable value, because by a simple reading off we are able to arrive at a measurement of the strength of the current as accurate as that attained by the actual collection of the gas.

The second point, which is of some technical interest, is that raised by the President, who expressed his opinion that the voltastat was not applicable to weak currents such as are required for the deposition of copper. I need only remind your readers that the tenacity of the copper film is not a mere function of the power of the battery, but also of the extent of the surface upon which the deposition takes place, and that the coveted state of aggregation of the copper is attained by extending the receiving surface, as well as by diminishing the strength of the current. *Cæteris paribus*, the deposited film is more coherent when the deposition takes place more slowly. Given a current of a certain strength—let the surface to be electroplated be exceedingly small, the copper deposit will crumble away as it is formed. Let now the current remain the same, but let the surface be extended, then in the same time the same amount of copper will be deposited, but being precipitated upon a larger surface it will be thinner;—the deposition will have taken place more slowly and the copper will be more tenacious.

From this cause alone the objection raised by the President would fall to the ground. But indeed no such extension of the polar surface is necessary. If a very weak current is required we have only to insert a tube of very small capillary opening. There is in fact no limit to the degree to which the strength of the current can be reduced by modifying the instrument.

The vivacious onslaught committed by Dr. Odling on graphic formulæ in general, and on Dr. Brown's especially, and of which a judiciously subdued account appears in your report, I would willingly leave for reply to Dr. Brown. But as the "humourous remarks" were called forth by my modification of Dr. Brown's scheme, I may be allowed a few words of reply.

In support of the use of graphic formulæ I am fortunately able to cite an authority of whom I have no doubt Dr. Odling entertains a very high opinion. This authority is Dr. Odling himself.

In his "humourous remarks" Dr. Odling appeared shocked at the idea of an atom of nitrogen supporting three "sticks," one in each hand, and one on its head. Strange objection from one who years ago trained his atom of nitrogen to the much more difficult acrobatic feat of balancing simultaneously three sticks on the tip of its nose,—N'''.

Or would not our Secretary rather liken his accents to an advertisement on the part of the element? "Willing to adopt, three hydrogen babies, or an oxygen boy and a hydrogen baby, or a full-grown phosphorus adult. Apply to N., care of Dr. O., &c., &c."

In seriousness, I am far from wishing to depreciate the system of accents introduced by our humourous Secretary. But as formulæ constructed with them are to all intents graphic formulæ, I am at a loss to understand why the graphic formulæ introduced by Dr. Brown should have so terrified our Secretary that he has sought refuge from Dr. Brown's "sticks" even beneath the once detested "buckle" of Kolbe.

It is surely a misconception on Dr. Odling's part to imagine Dr. Brown's double bond to indicate a double strength of attachment; a misconception arising from a confusion between number and quantity.

I refrain from following Dr. Odling in his connubial illustrations, which combined great humour with considerable pathos.

Your correspondent "F.C.S.," in the same number, arrives at the conclusion that there is little new in my scheme, and that that little is bad. Let me endeavour to reply to some of the remarks of "F.C.S."

Though my symbols for water and bromine resemble the ordinary symbols for division and multiplication, yet, since the latter operations are at present scarcely employed in chemical formulisation, there can be but little danger of ambiguity arising from this source. The dots and accents employed by Berzelius and others, for oxygen and sulphur may, perhaps, be still employed by "F.C.S.;" but, I imagine, by few others. The resemblance between my symbol for oxygen, and the minus sign, can be of little consequence, because the minus sign need never be used.

I am fully aware that I am not the first to employ differently shaped figures to represent different elements. The hieroglyphics employed by the alchemists, and which still linger in pharmacy, are arbitrary. So are those mentioned by "F.C.S." The symbols whose use I suggest have a meaning. The novelty which I claim for my modification of Dr. Brown's scheme, is this:—The figures employed by Dr. Brown are, I think, difficult to read at a glance; the only graphic difference between the symbols for different elements being the number of linear attachments. The "atomicity" in my symbols is shown by the form of the symbol itself. I need only add that the sole reason I have for adopting these special symbols is, that they are the simplest I can find to express my meaning.

With regard to incompleteness, I fully admit the charge, and invite "F.C.S." to make the system more complete. As it stands, my plan is, of course, little more than a sketch; but, unimportant as it may be, it is for the consideration of chemists rather than of humourists.—I am, &c.,

FREDERICK GUTHRIE.

Edinburgh, April 28th, 1868.

SCIENCE TEACHING IN SCHOOLS.

To the Editor of the Chemical News.

SIR,—I cannot see that it was unwise to form a judgment on the tone of Mr. Rodwell's teaching from the published conclusions to two courses of his lectures, when each conclusion seemed to give the same indications. A teacher of science generally sums himself up in the final remarks of his course of lectures; and Mr. Rodwell appeared to have followed the usual custom.

As a matter of fact I could not understand the conclusions—I found them, in a marked degree, scholastic; I then inferred that a scholastic tone ran through the lectures, and from this, that they "were not adapted to attract boys to science." Mr. Rodwell objects to the mode in which I arrived at this conjecture, and then quoting it, adds—"they would not be fulfilling their object if they sought to do this;" hence it appears that they were not meant to attract, and it is an obvious probability that they were not adapted to attract.

However, I cheerfully concede to Mr. Rodwell that I am not in possession of sufficient material for forming an adequate idea of his lectures, and if I have misjudged him, I ask his forgiveness.

Setting particular schools and individuals aside, the imperial question remains—How is science to be taught in schools? If boys are to be elevated by means of science, it must of course be made a serious study; but, on the other hand, it should not be taught in the same hard, dry way in which classics have been taught. Phenomena should be explained simply, and I assert that the most talented and laborious teacher will not find his powers any too much for this. Theories that can be appreciated only by savants should not be introduced.

This is what I mean by the popularisation of science, and we want men to carry out this work. We do not want a temple to worship in, nor a haughty priesthood to exhibit to us a shrine; we want men who have been endowed with the means, leisure, and love for the work, to discourse to us in our own language on the works of nature, and to walk with us in the paths of real knowledge.—I am, &c.,

D.

MISCELLANEOUS.

Caution to Bakers.—On Friday, April 24th, at the Winchcombe Petty Sessions, before the Rev. R. Wedgewood and J. Waddigham, Esq., county magistrates, George Smith, baker, was summoned at the instance of J. C. Dent, Esq., for having adulterated his bread with alum. The charge was clearly established by Mr. Horsley, of Cheltenham, county analyst, who made a series of interesting experiments, the result of which was that the defendant was convicted, and fined £8 and costs, including the analyst's charges.

New Training College, for Veterinary Students.—It is proposed to start a New Training College in September next, under the presidency of Professor Tuson. This College will be founded for the purpose of supplying an admitted want, namely, an institution in which youths intended for the professions of Veterinary Medicine and Agriculture can be furnished with that preliminary general and scientific education which is so highly essential—1stly. To enable them to quickly comprehend the technical terms employed in the various branches of Medical and Agricultural Science, to follow the reasonings of lecturers and authors, and therefore to readily and thoroughly master the subjects which engage their attention while pursuing the advanced and professional courses of study taught in Veterinary and Agricultural Colleges. 2ndly. To enable them to grasp principles, to appreciate their value, and to acquire the power of applying them with facility in the practice of their professions. 3rdly. To enable them to raise the dignity and increase the importance of their callings, and to fit them for occupying that social position which is allotted to every educated man. The curriculum of study will comprise English, Arithmetic, Latin, French, Geometry, Algebra, Zoology, Botany, Physics, Chemistry, and Practical Chemistry. For the latter purpose a laboratory will be provided, in which instruction will be given in the rudiments of Analytical and other branches of Experimental Chemistry. The curriculum is so arranged that youths of average ability and industry may pass through it in one session. The session will be divided into three terms.

Royal Institution of Great Britain.—At the annual meeting, held on Friday, May 1, 1868, W. Poole Esq., in the chair, the annual report of the committee of visitors for the year 1867 was read and adopted. The books and pamphlets presented in 1867 amounted to 131 volumes, making with those purchased by the managers, a total of 319 volumes added to the library in the year, exclusive of periodicals. Forty new members were elected in 1867. Sixty-three lectures and twenty evening discourses were delivered during the year 1867. Thanks were voted to the President, Treasurer, and Secretary, to the Committees of Managers, and Visitors, and to the Professors, for their services to the Institution during the past year. The following gentlemen were unanimously elected as officers for the ensuing year:—*President*—Sir Henry Holland, Bart. M.D. D.C.L. F.R.S. *Treasurer*—William Spottiswoode, Esq. M.A. F.R.S. *Secretary*—Henry Bence Jones, M.A. M.D. F.R.S. *Managers*—Henry Wollaston Blake, Esq. M.A. F.R.S.; Charles Brooke, Esq. M.A. F.R.S.; Adm. Sir Henry John Codrington, K.C.B.; Captain Douglas Galton, C.B. F.R.S.; John Peter Gassiot, Esq. F.R.S.; William Robert Grove, Esq. M.A. Q.C. F.R.S; Cæsar H. Hawkins, Esq. F.R.S; Sir John Lubbock, Bart. F.R.S. Pres. Etom. Soc.; Sir Roderick I. Murchison, Bart. K.C.B. D.C.L. F.R.S.; William Pole, Esq. M.A. F.R.S.; William Frederick Pollock, Esq. M.A.; Robert P. Roupell, Esq. M.A. Q.C.; Lieut.-Gen. Edward Sabine, R.A. D.C.L. Pres. R.S.; Sir Charles Wheatstone, D.C.L. F.R.S.; Colonel Phillip James Yorke, F.R.S. *Visitors*—Andrew Whyte Barclay, M.D.; Charles Beevor, Esq. F.R.C.S.; John Ashton Bostock, Esq.; John Charles Burgoyne, Esq.; Rev. Charles Fynes Clinton, M.A. F.R.G.S.; Alfred Davis, Esq.; William Dell, Esq.; Rev. G. Codwin Pownall Glossop, A.M.; Alfred Gutteres Henriques, Esq.; Edward Henry Moscrop, Esq.; William Newmarch, Esq. F.R.S.; Arthur Giles Puller, Esq. M.A. F.S.A.; Samuel Scott, Esq.; Edward Owen Tudor, Esq. F.S.A.; Robert Ballard Woodd, Esq. F.S.A. F.R.B.S.

The Royal Society.—At the meeting of this Society last evening, the names of the 15 candidates whom the Council recommended for election into the Society were read from the chair. The only chemists in the list are—A. V. Harcourt, Esq., and P. Griess, Esq.

NOTES AND QUERIES.

Trinidad Pitch.—A correspondent wishes to know where he can purchase Trinidad pitch.—L. Y. E.

Bleaching Woollen Rags.—George Watson, of Manchester, would be glad if any of your correspondents could inform him what is best for bleaching woollen rags previous to being torn up.

Colour of the Sea.—Cerebric Acid.—1. Where can I find the best account of Father Secchi's observations on the cause of the colour of the sea? 2. Is there any authority (and if so, whose) for the statement made in "Marshall's Physiology," vol. ii, p. 114, that cerebric acid is found in Indian corn, and to less extent in wheat? And if cerebric acid be really present does it of necessity arise from protagon?—F.R.S.

MEETINGS FOR THE WEEK.

Tuesday.—Royal Institution 3. Dr. M. Foster "On the Development of Animals."

Wednesday.—Society of Arts, 8.

Thursday.—Royal Institution 3. Professor Bain, "On Popular Errors."

Friday.—Royal Institution 8. E. Deutsch, Esq., "On the Talmud."

Saturday.—Royal Institution, 3. Professor Bain, "On Popular Errors."

TO CORRESPONDENTS.

Science Teaching.—There is no better firm than the one you mention.

Enquirer.—The information is given in the present number.

Thos. Spencer.—Mr. Muter's letter on the permanganate water-test renders your communication unnecessary.

G. Benson.—Dissolve commercial aniline in dilute hydrochloric acid, evaporated nearly to dryness, and recrystallise two or three times from water.

G. Spencer.—We regret that it is out of our power to give the information required.

S. A. Sadler will receive a private communication in a few days.

Tyro.—Where the word salt is used by itself, common salt or chloride of sodium is intended to be expressed.

A. Smith.—A full account of the results obtained by the Editor, in his investigations on thallium, down to January, 1864, together with a list of memoirs, is published in the "Journal of the Chemical Society," vol. xvii., p. 112.

E. Corbett, Junr.—We cannot say for certainty that they are patented, but it is extremely unlikely that such valuable processes should not be patented in this country.

Johnson's Patent Stoppers.—A correspondent wishes to know where these can be obtained.

W. O. Gervaus, Ohio, U.S.A.—Robbins's oxygennesis is a mixture of binoxide of barium and bichromate of potash, both dry and in fine powder. On adding hot water or dilute acid to the mixture, oxygen is evolved.

C. L.—Mix modelling clay with glycerine instead of water. This will cause it to remain plastic.

Communications have been received from E. Corbett, junr.; H. Thompson; W. O. Gervaus, Delaware, Ohio, U.S.A.; W. Hackney; Professor Maynard, Troy, N.Y., U.S.A.; M. A. Whichelo; J. Spiller; W. F. Barrett; O. Scevola; W. White; Dr. R. Angus Smith, F.R.S.; H. Morton; W. Arndt; J. Heywood; J. Marples; Longmans and Co.; Churchill and Sons; J. A. Pooley; M. G. Maurice; W. A. Townsend and Adams.

Books Received.—"The Inductorium or Induction Coil," by Dr. Noad, F.R.S. London: John Churchill and Sons; "Tea," by E. F. Bamber. London: Longmans and Co.; "Sanitary Siftings on Results of Sewage Systems Compared," by a Naval Officer. London: E. and F. N. Spon; "On Liquid Fuel," by Benjamin H. Paul, Ph.D. London: E. and F. N. Spon; "The Colonial Monthly, an Australian Magazine," December, 1867, and February, 1868; "On Dr. Muspratt's Discovery of a new Spa at Harrowgate;" "The Chemical Manufactories' Directories of England, Scotland, and Ireland." London: W. Kent and Co.; "A Dictionary of Chemistry," by Henry Watts, F.RS. Part xlv., completion. London: Longmans and Co.; "The Journal of Materia Medica:" "A Key containing Answers to the Exercises in Galloway's First Step in Chemistry." London: John Churchill and Sons; "Annual Register of the Rensselaer Polytechnic Institute, 1867-68."

THE CHEMICAL NEWS.

Vol. XVII. No. 441.

ON MONOCHROMATIC LIGHT.

By HENRY MORTON, Ph.D.,
Prof. Chem. and Phys., University, Penna.

The difficulty of producing monochromatic light in great quantity prevents us from demonstrating satisfactorily many points of interest in connection with the composition of light, and the theory of vision. Coloured glasses placed in the path of powerful beams of white light are doubly unsatisfactory; they reduce the amount of light enormously, and, with few exceptions (*e.g.*, red glass coloured with gold), yield a beam of mixed colour.

The old experiments of snap-dragon, or the spirit lamp with salted wick, are admirable as far as they go, but yield a very faint light at best. Something far superior to this is furnished by the arrangement of a ring of cotton wick wound on a wire, and supported immediately over and around a large Bunsen burner, the wick being soaked with an aqueous solution of some flame-colouring salt. This plan in effect is suggested in Sir David Brewster's natural magic; but as the Bunsen burner was not then known, a less simple arrangement is described to perform the same office.

The drawbacks to this arrangement are: the trouble of adjusting the cotton wicks, the delay in changing to produce a new colour, and the brief duration and, to a certain extent, irregular amount of the effect.

After lighting, the burners increase their effect to a certain point, and then soon rapidly diminish in the intensity of their light.

When a large number of burners are to be used these difficulties become serious, and I have therefore devised the following arrangement, which has proved, on trial, thoroughly efficient:—The burners to be used, varying in number from 5 to 30, in different experiments, are enclosed below in a box with a single large entrance, opposite to which is placed an atomiser, operated either by steam or compressed air.

A spray of the colouring solution is thus mixed with the air supplying the burners, and their flames are thus tinged with the greatest ease, certainty, and intensity of effect, the whole action being entirely under control, and capable of being maintained indefinitely, while the change from one colour to another is effected by simply transferring the tube of the atomiser from one solution to another.

For experiments demanding diffused light, this apparatus is most satisfactory. Five large Bunsen burners, thus arranged, light up the lecture room of the Franklin Institute, which seats about 350 persons; and with 60 burners, arranged in two groups of 30, I expect to illuminate sufficiently, at my next lecture, the Academy of Music, which has 3,500 stalls. Of course in neither case is the light brilliant, but simply sufficient to show in the most distant portions of the room the peculiar effects of this light on the faces and dresses of the audience themselves. Any object near the flame is, however, brightly illuminated.

The stage being set with the most brilliant scenery and coloured decorations, suddenly illuminated by yellow light thus developed, the ordinary gas-light being turned down, presents an appearance of ghastly change, which cannot be appreciated until seen, while sufficient light reaches all parts of the house to allow the audience to repeat the strange observation of metamorphosis upon their neighbours.

In certain experiments, however, it is necessary to have monochromatic light of great intensity and concentration.

This I have found could be furnished in the case of yellow light, to a certain extent, by substituting in the gas microscope or polariscope a soda-glass rod for the ordinary lime cylinder, and so adjusting its position that the rays from the heated glass should be cut off from the lenses, and only the light of the yellow flame should reach them.

We can thus show, upon a screen 5 ft. in diameter, the greatly-increased number of rings developed by a section of iceland spar in monochromatic light.

With the spectroscope we can also project the sodium line on the screen, so as to be well seen by an audience of 500 persons. By afterwards producing the absorption-band due to the vapour of the substance, with the aid of a small Bunsen burner and iron spoon with sodium, and again showing the absorption-bands of nitric peroxide and of cochineal, the characteristic phenomena of spectrum analysis may be sufficiently illustrated, without the trouble and expense of the electric light.

We have, in fact, with a large and efficient battery at command, generally employed the above arrangement by preference.

The details of adjustment we will furnish, with pleasure, should any one think it of sufficient interest to ask for them.

ON THE PREPARATION OF MAGNESIA FOR RESISTING HIGH TEMPERATURES.

By M. H. CARON.

About two years ago I briefly pointed out the advantages which would accrue to metallurgy from the employment of magnesia as a refractory material. I regretted, at the same time, the high price of this earth, the employment of which appeared likely to be confined to the laboratory. Now, circumstances have happily changed; recent modifications introduced into the manufacture of cast steel, and especially the employment of Siemens's furnace and Martin's process, absolutely demand more refractory bricks than those at present in use, irrespective of price. On the other hand, native carbonate of magnesia, which formerly cost 250 fr. the 1000 kilos., may now be obtained at the price of 70 fr. delivered at Marseilles, or 100 fr. delivered at Dunkirk. Calcination at the place where the carbonate is obtained, may still further reduce its price.* I desire now to describe my processes for its agglomeration, which may be employed by the chemist for the ready preparation of refractory vessels of all forms; by the physicist to obtain pencils for oxyhydrogen lighting purposes; and also by the manufacturer, to replace, in some cases, fire-bricks which have become insufficient in carrying out different processes of heating.

The magnesia which I employ comes from the island of Elba, where it is found in considerable quantities as a native carbonate, white, very compact, and of great hardness. This carbonate contains traces of lime, silica, and iron; it is, besides, interspersed sometimes with serpentine and large plates of silica, which would diminish the infusibility of the subtance, and render it especially unfit for oxyhydrogen illumination if their removal is neglected (I will presently give the reason). These plates are, however, easily recognised, and may be readily separated, even in working on the large scale. In the case of refractory bricks, the presence of a small quantity of these foreign bodies would, at the most, give rise, under the influence of the highest temperatures, to a slight vitrification, offering no serious inconvenience.

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* This preliminary calcination requires less heat than burning lime, and diminishes the weight of the carbonate one half.

Before powdering the carbonate, it is advisable to bake it at the temperature necessary for the expulsion of the carbonic acid; the material then becomes very friable, add may be pulverised more easily. It is then possible to separate the serpentine and silica, which do not become friable under the influence of heat. This preliminary treatment does not permit of the agglomeration of the magnesia, and even were this difficulty to be overcome, a temperature higher than that of the original calcination would cause an enormous contraction, producing fissures and alterations in shape, which would interfere with the use of this substance. It is, therefore, indispensable, before moulding the magnesia, to submit it to a very intense heat, at least equal to that which it is intended to support subsequently.

Thus calcined it is not plastic, its appearance is sandy, and compression does not cause it to acquire any cohesion; a mixture of magnesia, less calcined, imparts to it this quality. The quantity of the latter to be added necessarily varies with the degree of calcination of the two magnesias; it is scarcely one-sixth of the weight of that which has been exposed to the temperature of melting steel. It only now remains to moisten it with 10 or 15 per cent of its weight of common water, and strongly compress it in iron moulds, as adopted in making artificial fuel. The brick produced in this operation hardens on drying in the air, and becomes still more resisting when it is subsequently calcined at a red heat. The same process would appear practicable, varying the form of the moulds, for obtaining crucibles of great capacity; but compression is difficult in large masses, as well as when the moulds have a large surface, as the magnesia adheres strongly to the sides. Although I have been able to obtain small crucibles for the laboratory, I do not consider this process adapted to make the large crucibles employed in steel melting. In this and other cases it is preferable to agglomerate the magnesia in the humid way.

To endow magnesia with a sort of plasticity, I have profited by a property of this earth pointed out in "Berzelius's Chemistry." When strongly calcined, and then moistened, it hardens in drying. This fact is doubtless due to a hydration which takes place without sensible increase of temperature. I have also remarked that when solidified in this manner the magnesia only loses the assimilated water at a high temperature. Then calcination not only does not disintegrate it, but on the contrary confers upon it a hardness and resistance comparable to those of ordinary crucibles after their baking. This being understood, the application of this fact is obvious. Thus, the magnesia to be employed in the manufacture of crucibles, should only be moistened, moulded into shape, dried, and then ignited. For the construction of steel melting furnaces, a paste of moistened magnesia should be plastered over the walls; it will become ignited in due course without any particular precautions being taken. It sometimes happens, however, either owing to the magnesia being too much or too little hydrated, or owing to its containing siliceous matter, that the vessels before or after firing do not possess quite the desirable solidity; they should then, to acquire this, be simply moistened in a cold saturated solution of boracic acid, dried, and then fired as before. This operation does not render the magnesia more fusible: it only causes the grains of the substance to cohere more strongly together.

Magnesia, very pure, strongly calcined and finely pulverised, may be employed in the form of paste (*barbotine*) and yield the most delicate and translucent crucibles, as well as the sharpest and most complicated impressions. I am convinced that some time hence this earth will be advantageously employed in the ceramic art in spite of its difficulties of its moulding compared with those of porcelain paste.—*Comptes Rendus*, lxvi. 839.

ON A NEW PROCESS IN MINERAL ANALYSIS.

By FRANK WIGGLESWORTH CLARKE, S.B.

In the course of some experiments upon the alkaline fluorides, I found that the most refractory minerals, such as emery, chromite, tinstone, rutile, &c., were completely and easily resolved by fusion with a mixture of fluoride of sodium and bisulphate of potassa.

The operation is performed as follows:—One part of the finely pulverised mineral is mixed in a platinum crucible with three parts of fluoride of sodium, and upon the top of this mixture are placed twelve parts of bisulphate of potash, which may be either in powder or in small lumps.

Upon heating, the mixture boils up strongly, and after a while settles into a clear, tranquil fusion. The boiling is chiefly owing to the action of the reagents upon the mineral, and not, as might be supposed, merely to the influence of the bisulphate upon the fluoride. This is shown by the fact that, whenever the reagents are heated together without minerals, although some boiling takes place, the addition of a little powdered chromite or iron ore fully doubles the violence of the action.

In quantitative analyses it is necessary to keep the crucible closely covered in order to avoid loss from spattering; and to heat carefully, so that the mass may not boil over. The bisulphate should never be mixed with the fluoride and mineral, because a portion of the assay is then apt to escape action, being left on the sides of the crucible by the boiling of the mass; but should be placed upon the top of the mixture as above directed, as then the decomposition is complete. The mass obtained by this fusion is, in the case of some minerals, completely soluble in water. In other cases, basic salts are formed, which, although insoluble in water, dissolve readily in hydrochloric acid. Almost all of the latter class may be rendered soluble in water by the following process:—The fused mass, after cooling, without removal from the crucible, is treated with a small quantity of strong sulphuric acid, and again fused. The mass thus obtained is entirely soluble in water. There are exceptions to this rule, however.

I will now describe the results I have obtained with various minerals, and for the sake of brevity, will speak of the fusion with bisulphate and fluoride as fusion No. 1, and the subsequent treatment with sulphuric acid, as fusion No. 2.

Tinstone is completely resolved, giving a white mass almost entirely soluble in *cold* water. A very small quantity of stannic acid remains undissolved, however, but by first treating the mass with hydrochloric acid and then adding water, complete solution is ensured. By rendering the solution *nearly* neutral, taking care, however, to leave a slight excess of sulphuric acid, then reducing the iron by sulphuretted hydrogen or hyposulphite of soda, and then boiling for some time, all the tin is precipitated in the form of stannic acid. If the ore contains tungstic, niobic, or tantalic acids, these also will be completely precipitated. A second fusion is of no advantage with tinstone. This is the only mineral which I have yet tested which was not completely resolved by this process, over an ordinary Bunsen's gas burner. This substance required the heat of a blast lamp.

Wolfram is entirely decomposed, affording a pale yellowish mass, partly soluble in water. Hydrochloric acid dissolves a part of the residue, but a white powder, probably the hydrate of tungstic acid, remains unattacked. Fusion No. 2 possesses no advantages with wolfram. I should not recommend the use of this process for the analysis of wolfram, as it is so readily decomposed by nitric acid. I made the experiment, however, because as wolfram is so often mixed with tinstone, it seemed to me necessary to know what the reaction would be.

Rutile.—This mineral is rapidly and easily resolved, giving a mass when cooled, of a yellowish white colour, and, as I obtained it, presenting a beautiful mottled appearance, being crystalline in structure, and in some parts nearly transparent, but opaque in others. This mass dissolved entirely in *cold* water, rendering a second fusion unnecessary. From this solution all the titanic acid may be thrown down by boiling.

Niobite is decomposed with the greatest ease. The mass is pale yellow, and partially soluble in cold water, but a small quantity of niobic acid remains undissolved, even in hydrochloric acid. But it is always best to treat with hydrochloric acid, in order to dissolve any basic sulphates of iron that may be formed. Upon boiling the filtered solution, niobic acid is precipitated.

Fusion No. 2.—A larger proportion of the mass is soluble in water than with the first fusion, as no basic salts of iron are present.

Ilmenite is completely decomposed, giving a mass closely resembling that obtained from rutile. *Cold water* dissolves a large part of this, but leaves some basic salts which dissolve readily in hydrochloric acid.

Fusion No. 2.—The resulting mass dissolves completely in *cold* water, and by boiling the solution, the titanic acid can be precipitated.

Chromic iron ore is decomposed very easily. In one case in which I timed the operation, *the fusion was complete in less than three minutes from the time I began to heat*, and that over an ordinary Bunsen's gas burner. The cooled mass is light green, partly soluble in water alone, and entirely soluble in hydrochloric acid.

Fusion No. 2.—The mass possesses a deeper green colour than that obtained by the first fusion, and a larger proportion of it dissolves in water. In every fusion that I have yet made of chromite, however, a small quantity of basic salts was formed, requiring treatment with hydrochloric acid.

Emery is rapidly and easily resolved. The mass contains basic compounds that require hydrochloric acid for complete solution; although water dissolves a large proportion of it.

Fusion No. 2.—The mass thus obtained is entirely soluble in water.

Hæmatite.—(An exceedingly hard specular ore from the Tilden mine, Lake Superior). It was completely resolved, giving a mass partially soluble in water, but dissolving entirely in hydrochloric acid.

Fusion No. 2.—The mass dissolves completely in water.

Limonite and *magnetite* behave exactly like hæmatite.

Zircon is entirely decomposed. All its silica is converted into the gaseous fluoride of silicon, and driven off. The mass obtained resembled that given by rutile. It dissolved almost entirely in cold water, but the solution speedily became turbid and deposited a white precipitate, which was either zirconia or some basic salt of that oxide. By first digesting the mass with a little strong hydrochloric acid and afterward adding water, the whole went into solution.

Fusion No. 2, afforded a mass of a beautiful waxy lustre, which was completely soluble in water.

Kyanite is entirely resolved, and, like zircon, freed from silica. The white mass contained basic compounds, and consequently required hydrochloric acid for complete solution. A second fusion gave a mass entirely soluble in water.

Orthite is completely decomposed, and deprived of silica. The mass was white, and dissolved partly in water. The insoluble residue contained basic salts and some sulphate of lime, and hydrochloric acid dissolved all but the latter.

Fusion No. 2—With the exception of a little sulphate of lime, the mass dissolved in water.

Quartz sand.—I subjected some of this substance to fusion with the mixture of bisulphate of potash and fluoride of sodium, in order to ascertain to what extent silica would be converted into fluoride of silicon. The fusion took place very easily, giving a white mass which dissolved almost entirely in water. Only a very small trace of insoluble residue remained, probably not more than one-tenth of one per cent of the quantity of sand taken. It is very probable that more careful treatment would get rid of even that small amount. After this it seems impossible to doubt that any and all silicates would be decomposed and freed from silica by this process. A convenient method is thus afforded for the estimation of bases in silicates, bearing in mind, however, that a second fusion with sulphuric acid will in most cases be necessary.

As far as concerns the complete resolution of any mineral, pure, finely pulverised cryolite may be substituted for fluoride of sodium. It labours under the disadvantages, however, of introducing alumina into the mass obtained, but nevertheless it can be advantageously employed in cases where the introduction of alumina is a matter of indifference, as in the technical analyses of tinstone and chromite, and the estimation of iron in ores, slags, and cinders. The perfectly white translucent specimens of cryolite should be chosen for this purpose.

Either the bisulphate of potash or of soda may be used, and although neither seems to possess any advantage in point of thoroughness, the potassa salt appears to be the most readily fusible, and is therefore to be preferred.

The following are the advantages that I claim for this process.

First. Speed. Among the different minerals upon which I have tested the action of this mixture, I have found no case where I was obliged to heat longer than five minutes, and many fusions are complete in three, and even less.

When bisulphate of potash *alone* is used for a similar purpose, it is usually necessary to heat for from half to three-quarters of an hour; and even then in the cases of emery, chromite, and some other minerals, it is almost impossible to obtain absolutely complete resolution.

By my process, even when the second fusion with sulphuric acid is necessary, not more than twenty minutes should be consumed in both fusions and the time for cooling between them.

Second. In every case except tinstone that has come under my observation, in my process, an ordinary Bunsen's burner may be used as the source of heat; whereas, by most other methods, a blast lamp is necessary.

Third. When bisulphate of potash *alone* is used for the decomposition of chromite, &c., it is necessary that the mineral should be reduced to extremely fine powder; but, when the mixture of bisulphate and fluoride is employed, although the mineral should be in fine powder, such an extreme state of subdivision is by no means required, and thus much labour is saved.

Fourth. In all cases when this mixture is used, the resolution of the mineral is absolutely perfect. Furthermore, all the silica is got rid of at once, and all the bases present are converted into sulphates. This last is a great advantage whenever iron is to be determined volumetrically by means of hypermanganate of potassa solution. As far as thoroughness of action is concerned, or generality of application, I can claim no advantage for my process over the use of acid fluoride of potassium; but the last-named reagent is difficult to prepare, and when prepared, cannot be preserved in glass vessels.

Fluoride of sodium is subject to neither of these disadvantages, and in the mixture with bisulphate of potassa, has slight advantages as regards rapidity of action.

It may not be out of place for me to mention here a fact connected with the use of fluoride of ammonium for decomposing silicates, as described by Rose. After fusing the mineral with the fluoride, he directs treatment with sulphuric acid, for the purpose of converting the bases into sulphates. I find that if, in the first place, sulphate of ammonia is mixed in excess with the fluoride, all the bases are directly converted into sulphates, thereby obviating the necessity of treatment with sulphuric acid.

This method *can* be used for the purpose of determining alkalies in silicates, but is far inferior to J. Lawrence Smith's process.

Technical Determination of Chromium in Chromite.—After fusion with cryolite and bisulphate of potash, as previously directed, the mass is to be treated with a little strong hydrochloric acid, and allowed to digest for about ten minutes. Then, upon boiling with water, the whole dissolves. The solution should then be neutralised, acetate of soda added, and the chromium oxidised to chromic acid by a current of chlorine gas, or by boiling with hypochlorite of soda solution. The chromium may then be separated from other substances, as directed in Professor Gibbs's paper, (*Am. Journ. Sci.*, January, 1865). When chromite is fused with bisulphate of potash and cryolite, and saltpetre is added to the mass, as soon as clear fusion is obtained, the chromium is nearly all oxidised to chromic acid. If the mass be boiled with a solution of carbonate of soda, and the liquid filtered, a filtrate is obtained which contains nearly all, but not quite all the chromium as alkaline chromates, free from iron or alumina; but, invariably, the residue upon the filter contains traces of chromium. When chromite is fused with the acid fluoride of potassium, a part of the chromium is usually oxidised to chromic acid by the oxygen of the air; and in one case that came under my observation, when I came to heat the resulting mass with sulphuric acid, red fumes were given off, which were probably the so-called terfluoride of chromium.

Technical Estimation of Iron in Ores, Slags, and Cinders.—After fusion with cryolite and bisulphate of potash, the mode of treatment varies according to the method it is desired to use for determination of the iron. If Penny's process of estimating iron volumetrically with bichromate of potassa, or the ordinary method of precipitation with ammonia is to be employed, the mass may be treated with hydrochloric acid, and thus brought immediately into solution. If, on the contrary, the iron is to be determined volumetrically by means of hypermanganate of potassa, the use of hydrochloric acid is interdicted, and it becomes necessary to fuse again with sulphuric acid and dissolve in water. When volumetric processes are used, the whole determination of the iron, from the time the assay is placed in the crucible, should take less than an hour to perform.

This process has a great advantage over all others, in the examination of ores, slags, and cinders containing iron, both as regards speed and convenience. A perfectly clear solution is immediately obtained without filtering, all the silica is got rid of, and it is only necessary to reduce the iron with hydrogen, and then to titrate. If in an iron ore it is desired to determine also titanic acid and manganese, it is best to make the subsequent fusion with sulphuric acid. The clear solution obtained is diluted to a known quantity, and by means of a graduated pipette divided into several portions. In one part the iron may be reduced and determined volumetrically; in another, the titanic acid thrown down by boiling. In still another portion, the iron, alumina, and titanic acid may be thrown down by boiling with acetate of soda, and in the filtrate, the manganese may be precipitated by a current of chlorine gas, or by boiling with hypochlorite of soda. If fluoride of sodium be used instead of cryolite in the fusion, lime and magnesia also may be estimated. For determining silica, phosphorus, and sulphur, other methods must be employed.

Preparation of Fluoride of Sodium.—When pure finely pulverised cryolite is boiled with caustic soda solution, it is, as is well known, decomposed. Fluoride of sodium is deposited as a jelly-like mass at the bottom of the vessel, and the supernatant liquid contains aluminate of soda, a little fluoride of sodium, and the excess of soda. The deposit of fluoride is to be washed with cold water until the washings have no longer an alkaline reaction; and is then purified by repeated solution and evaporation. It is so difficultly soluble, and crystallises so badly, that this last is a matter of some difficulty; but the first part of the process is so very easy that the crude fluoride of sodium can be prepared by the hundred-weight without much trouble. Iron vessels are suitable for the operation, but must be very clean and free from rust. If caustic potassa be substituted for soda, the deposit of fluoride of sodium is smaller, and the supernatant solution contains aluminate of potassa, fluoride of potassium, and a little fluoride of sodium.

Possibly the fluoride of potassium might be prepared in a state of purity from this solution, but it is extremely problematical whether this could be done economically. When pure cryolite is fused with carbonate of soda, and the fused mass powdered and treated with water, fluoride of sodium is dissolved out. This method, however, cannot compare with the first for convenience and economy.

It may not be altogether out of place to remark in this connection, that I find that when fluoride of sodium is heated with sulphate of ammonia, fluoride of ammonium is formed and sublimes. Possibly this may be turned to advantage, although I have made no experiments upon obtaining fluoride of ammonium in quantity by this process.

Before closing this paper, I also wish to state that I made numerous experiments with a view toward applying the mixture of fluoride of sodium and bisulphate of potash to the estimation of both oxides of iron when they occur in minerals; but I met with no success.

During the course of the experiments described in this paper, I hade been largely indebted to Dr. Wolcott Gibbs for many very valuable suggestions and much excellent advice which aided me exceedingly.—*American Journal of Science*, xlv., 173, March, 1868.,

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CHEMICAL RESEARCHES ON SUGAR REFINING.

By M. EMILE MONNIER.

If sulphurous acid gas is conducted into a chamber containing coarse sugar, the latter is promptly bleached, and about three-fourths of the colouring matter are entirely destroyed, whilst the sugar undergoes no change whatever in composition. After this treatment the sugar smells strongly of sulphurous acid, which presents no inconvenience in the process of refining. To bleach sugar in this manner, for 1,000 parts by weight of sugar about four parts of sulphur must be burnt, and the gas conducted into the chamber. When the operation is once set going, the proportion of sulphur may be notably diminished. The sulphur is converted into gas by combustion in a little furnace placed at the side of the chamber. When the action is complete, the sugar is dissolved in water, and its sulphurous acid neutralised by a small quantity of lime. This lime may be previously converted into sucrate of lime by M. Peligot's method, that is, by crushing it with a little syrup; for 1,000 lbs. of sugar three or four lbs. of lime are requisite in the form of sucrate.

M. Monnier has been at great trouble to ascertain whether the sulphurous acid gas thus used modified the sugar so as to produce a certain amount of grape or non-crystallisable sugar, and he has convinced himself that sugar bleached in this manner undergoes no change whatever. The quantity of non-crystallisable sugar found by analysis after the operation in question was, in each case, exactly equal to the amount which the sugar contained before being bleached; namely, on the average, about 2·15 per cent. In all these experiments the sugar was exposed about forty-eight hours to the bleaching action.

The above process gives most striking results with exotic sugars, which are highly coloured; with lighter coloured samples, the bleaching is not so marked; but in the former case, two-thirds to three-fourths of the heterogeneous colouring matters are eliminated completely.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 7.

Dr. Warren de la Rue, F.R.S., &c., President, in the Chair.

This meeting, as is usual on the special occasions set apart for lectures, was exceedingly well attended, and several visitors honoured the Society with their presence. Mr. E. Dowson was formally admitted as a Fellow, and Mr. Thomas Bournes, Teacher of Chemistry, 47, Rigby Street, St. Helen's, Lancashire, was duly elected. The names of candidates read for the first time were Mr. William Bowyer Miller, Assayer, Royal Mint, Sydney; and Mr. William Hustler, Mining Engineer, Rosemerryn, Falmouth.

Mr. C. W. Siemens, F.R.S., delivered a lecture "*On the Regenerative Gas Furnace as applied to the Production of Cast Steel.*" The lecturer announced himself to have been a pupil of Wöhler, and said he was prepared to estimate highly the value of chemical science in directing the studies of the engineer and electrician. The regenerative gas furnace, which has during the last few years been applied to the manufacture of iron and glass, and is destined to play an important part in other chemical operations, is the joint invention of Mr. Frederick Siemens and the lecturer. It was described in 1862 by Professor Faraday, and formed the subject of his last public lecture in the Royal Institution. Before proceeding to enter upon the discussion of the furnace itself, and its peculiar details of construction, Mr. Siemens briefly sketched the properties and modes of preparation of cast steel. This product was defined as being "a compound of iron and carbon, possessing the remarkable quality of becoming exceedingly hard when heated and suddenly cooled." The proportion of carbon determines its temper, and the following table, which was shown in the form of a diagram, indicates the average composition of steel of different qualities:—

Description.	Carbon per cent.	Authority.
Wootz	1·34	T. H. Henry.
Steel for flat files	1·2	Willis.
,, for turning tools	1·0	,,
,, (Huntsman's) for cutters	1·0	,,
,, for cutters	0·9	,,
,, for chisels	0·75	,,
Die steel (welding)	0·74	,,
Double shear steel	0·7	,,
Welding steel	0·68	,,
Quarry drills	0·64	,,
Mason's tools and ramrods	0·6	,,
Common steel for stamping	0·42	,,
Spades and hammers	0·3 to 0·32	,,
Bessemer steel for rails	0·25 to 0·30	Various.
Homogeneous metal (armour plates)	0·23	Percy.
Very mild steel from open furnace	0·18	Willis.
Sample, before adding spiegeleisen	0·05	,,
Bessemer iron (pure)	trace	Abel.

Steel containing 1·4 per cent of carbon partakes of the character of white cast iron, and below 0·3 per cent the metal is incapable of being hardened. M. Frémy's opinion, that nitrogen (or cyanogen) is a necessary component of steel, was alluded to, and the probability of other elements being essential to its constitution was guardedly asserted. The presence of sulphur and phosphorus are undoubtedly prejudicial when they occur in considerable quantities, but the lecturer considers that traces of these elements may sometimes prove advantageous by increasing the fluidity and toughness of cast steel. The use of manganese fluxes, according to Heath's patent (1839), rendered it possible to prepare good steel from ordinary qualities of English puddled iron; and Mushet's discovery of the important advantages to be gained by the employment of ferro-manganese, or spiegeleisen, had paved the way to Mr. Bessemer's later triumphs. In the opinion of the lecturer, manganese has a special action in improving the quality of steel, apart from its function in removing sulphur and other impurities. Silicon, when present to the extent of 0·5 per cent, rendered it impossible to forge the ingots, but small quantities seemed, on the other hand, to be advantageous by preventing the evolution of gas in the interval between casting and solidification. The evidence respecting the effects of titanium, tin, and arsenic, was not conclusive; but Dr. Werner Siemens showed, in 1853, that tungsten had a remarkable action upon steel, in increasing its power of retaining magnetism when hardened. This property of tungsten was illustrated in the lecture-room by a small permanent magnet of horse-shoe form, which supported twenty times its own weight from the armature; the famous Haarlem magnet being incapable of lifting a weight more than thirteen times heavier than itself. The steel of which Mr. Siemens's magnet was made, contained about 2 per cent of tungsten, and 0·4 of carbon.

Reference was then made to the several processes of preparing steel, which were considered under the following heads, viz.:—The direct process in the Catalan forge; the method of cementation; the decarburisation process, or that which furnishes "puddled steel;" the Bessemer process; and, lastly, other methods of producing cast steel by fusion of malleable iron, or iron-producing substances, with cast iron, spiegeleisen, or other compounds containing much carbon, such as those practised by Uchatius, Price and Nicholson, G. Brown, Attwood, and others.

Experiments on the direct production of steel by a fan blast on an open hearth, according to M. Sudre's method, were made under the supervision of M. St. Claire-Deville and other two members of the French Institute; but the rapid destruction of the furnace, combined with the great cost for fuel, rendered the process a doubtful success. The applicability of the regenerative gas furnace to the fusion of steel and other metallurgical products, was partly established by the trials of Mr. Charles Attwood, in 1862, and of M. Lechatelier a year later, at Montluçon in France; the gentleman last named melted together hot puddled blooms and cast iron upon a bed of the aluminous mineral known as bauxite, and subsequently upon a bottom formed of common white sand. Later, in 1864, MM. Emile and Pierre Martin melted steel, both in pots and on the open hearth, by the aid of the gaseous fuel of the regenerative furnace. Their products, consisting of cast steel of various qualities, were shown at the French International Exhibition, and rewarded by a gold medal. With the view of making for himself a series of practical trials on the production of steel, Mr. Siemens constructed two experimental furnaces, in Birmingham, and succeeded in preparing steel of good quality, not only in closed pots, but on a continuous system direct from the ore. The details of these furnaces were explained with the help of large diagrams and dissecting models, whereby the leading points of their construction were clearly demonstrated. The principle of Mr. Siemens's plan of heating is already well known; the ordinary form of regenerative gas furnace having, indeed, been recently described by Mr. Henry Chance, who advocated its use in glass making. The fuel is heaped upon an inclined fire-grate, where it undergoes a kind of slow combustion, which results in the formation of carbonic oxide; this inflammable gas is then conducted from the "producer," to the hearth or working platform of the furnace, where it meets a current of air already raised to a high temperature, which enables it to burn with great intensity, and the excess of thermal power, instead of being allowed to pass directly into the chimney, and become thus wasted, is forced to traverse an intricate structure of brickwork, which absorbs so much of the heat, that the escaping gaseous products of combustion rarely indicate a temperature above 300° Fahr. At a suitable stage of the operation the gas valves are reversed, and both carbonic oxide gas and air forced to traverse these heated brick chambers in a contrary direction, so that they may in turn become the recipients of that heat which, in ordinary constructions of furnaces, would have been lost. The ashes and clinkers are in this way entirely separated from the region of manipulation, and are removed from the grate at intervals of one or two days. The composition of the inflammable gas varies with the nature of the fuel and the draught of the furnace; by way of illustration, Mr. Siemens quoted the following, as representing an average result for the gas from the producers at the St. Gobain plate glass works, where caking coal is employed in admixture with one-fourth of a non-caking quality:—

Carbonic oxide	24·2
Hydrogen	8·2
Carburetted hydrogen	2·2
Carbonic acid..	4·2
Nitrogen	61·2
	100·0

Besides the above, there are always present aqueous vapour, tarry matters, and small proportions of sooty and earthy particles. The author estimates the temperature of the gas as it rises from the fuel at 1000 to 1300° Fahr., but it becomes considerably hotter in its passage to the area of combustion beneath the crown of the furnace. An ingenious electric resistance pyrometer, with platinum helix, which has done good service in measuring these elevated temperatures, was exhibited; and an experiment was performed in the lecture-room, for the purpose of demonstrating the principle of the "regenerators," lead being melted in the reversed current of hot air blown through a heated stack of flints previously ignited over a Bunsen burner. The special furnace, which serves for the direct production of steel, has a tunnel head, or cylindrical hopper, fed with iron ore and small coke passing through, and raised above, the crown of the regenerative gas furnace; the lower part of this upright cylinder rests in a bath of molten pig-iron, which dissolves the reduced (spongy) iron as quickly as it is separated from the ore. A blast-pipe descends through the stack of ore, and the process is interrupted when the steel is ready for casting, after which the charge of pig must be renewed.

In the case of using bar iron (worn out rails) in the preparation of steel, they were introduced into an inclined hopper with their lower ends resting in a bath containing 10 per cent (by weight) of molten pig; and the atmosphere of the furnace might be changed at will into an oxidising, reducing, or perfectly neutral condition, merely by altering the proportions of air and gas. It is important to keep the carbon at a minimum, for then the silicon is lowest.

The lecture was amply illustrated by a series of diagrams showing the construction of the several kinds of regenerative furnaces in plan and section, and a large model of a gas producer was upon the table. The following specimens were also exhibited:—

Cast steel produced by melting Bessemer scrap in Siemens's furnace.

Cast steel produced by melting iron rail ends from Hayance, France, containing nearly 1 per cent of phosphorus.—Siemens's furnace.

Magnet steel containing tungsten.—Pot furnace.

Steel made in open furnace from Staffordshire iron.—Carbon, 0·37 per cent.

Steel from puddled iron from Creusot.—Open furnace. Carbon, 0·38 per cent.

Ingot of steel made in open furnace from red and cold short metal.—Carbon, 0·4 per cent.

The same metal tilted.

Steel made from Bessemer scrap in open furnace, containing 0·46 per cent of carbon.

The President, having proposed a vote of thanks to the lecturer, took occasion to remark that the regenerating furnaces offered special facilities for making experiments upon steel, with the view of ascertaining the effects of different adventitious substances. The statement of the wonderful magnetic properties of tungsten steel surpassed all that the Dutch had accomplished, and it would now be interesting to study the influence of boron.

A discussion followed, in which Mr. Cowper, Professor Abel, Dr. Miller, Dr. B. H. Paul, Dr. Williamson, and Dr. Odling took part. The meeting was then adjourned until the 21st instant.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, March 13, 1868.

"*On the Probable Exhaustion of our Coal Mines,*" by W. Stanley Jevons, M.A., Professor and Cobden Lecturer on Political Economy in Owens College, Manchester.

(Concluded from page 220.)

No statements of the total amount of coal produced in this kingdom are the least to be relied on, except those collected by Mr. Robert Hunt, the Keeper of Mining Records, and the following is a statement of the general progress of the coal trade of the United Kingdom as ascertained by him:—*

Year.	Coal raised. Tons.	Coal exported. Tons.
1854	64,661,000	4,309,000
1855	61,453,000	4,976,000
1856	66,645,000	5,879,000
1857	65,394,000	6,737,000
1858	65,008,000	6,529,000
1859	71,979,000	7,081,000
1860	80,042,000	7,412,000
1861	85,635,000	7,222,000
1862	83,968,000	7,694,000
1863	88,292,000	7,529,000
1864	92,787,000	8,063,000
1865	98,150,000	8,585,000
1866	101,630,000	9,367,000

It is impossible to view, without some degree of alarm so rapid an increase of the coal trade as the preceding figures indicate. Without doubt our production will advance to 200 millions before very many years are past; and the alarming calculation may be made that if we went on increasing our production of coal for 110 years as rapidly as we have done during the last 12 years, our coal seams would be worked out to a depth of 4000 feet. But such a supposition is put forward, not as a serious possibility, but as a *reductio ad absurdum*. The conclusion to be drawn from it is simply that the nation cannot possibly progress in material wealth for 110 years more as rapidly as it has done in the present century. The limited extent of our coal-fields would not allow us to go on increasing the draught of coal as lavishly as we have done. But it is the very necessity of changing from a highly progressive to a less progressive or stationary condition, that is most grievous. Population and production, when once set in motion, move with a certain impetus, and it is the check to such motion which is distressing and threatening.

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* I am kindly informed by Mr. Hunt that when the returns of the consumption of coal in 1867 are completed, the total will probably amount to 104,000,000 tons, showing continued increase in spite of the depression of trade.

VIII. The subject wears a more serious aspect still when we consider the coal resources and production of other countries as well as our own.

According to the latest returns which are at hand, it would seem that the total known produce of coal in the world is thus distributed over the chief nations:—

	Tons.
Great Britain	101,630,000
United States	25,800,000
Prussia and the Zollverein	20,610,000
France	10,710,000
Belgium	9,935,000
Austria	4,500,000
British North America ..	1,500,000
Russia..	1,500,000
Spain	300,000
New South Wales	250,000
Ireland	123,500
Total	176,858,500

It would appear then that of the total *known* produce of coal in the world we raise considerably more than half (57 per cent), although we form probably not more than one in forty of the population of the world. If to our own coal produce we add that of the United States and our colonies, we may conclude that the Teutonic race enjoys 73 per cent, or almost 3 parts out of 4, of the coal raised. It is hardly possible to over-estimate the forces acting in our favour which are represented by this partial monopoly of the most powerful material agent of civilisation.

The total quantity of coal existing can hardly be said to be known in the case of any one country; but some notion of the comparative coal resources of different countries may be gained from the following statement of the area of the coal-measures in the chief coal-producing countries, as estimated by Professor Rogers:—

	Area of Coal Lands in square miles.
United States	196,650
British North American Possessions	7,530
Great Britain	5,400
France	984
Prussia	960
Belgium	510
Bohemia	400
Westphalia	380
Spain	200
Russia	100
Saxony	30

Though Great Britain is far more abundantly provided with coal than any continental nation, our resources sink into insignificance beside those of North America, and no very long period will elapse before this comparative poverty in coal will make itself felt.

IX. It is continually suggested, indeed, that before coal is at all likely to be exhausted, some substitute will be found for it, and appeal is made to some old proverb, like "Necessity is the mother of invention." But it requires very little philosophy to see that the proverb is very partially true. We live in a chronic state of necessity and difficulty, and the great discoveries which we enjoy are but so many exceptional instances in which we have been unexpectedly relieved from labour and evil. We have no real ground for supposing that when one exceptional advantage is withdrawn from us, another will immediately be extended to us.

The favourite notion that electricity will be the future source of power is entirely fallacious; for the coal-driven engine moving the magneto-electric machine is now the cheapest source of electricity, and by gradual improvements, such as that in Mr. Wilde's machine, coal will become a still cheaper source of electricity. Even the elements of the electric battery have always been practically furnished by the reducing power of coal. If coal then become, as there is every reason to suppose it will, a cheaper and cheaper source of electricity, it is obviously absurd to suppose that electricity should supersede the power of coal.

It is conceivable, indeed, that in the course of ages some wholly new source of power might be discovered; but there is no reason to suppose that this island, which forms but the one four-hundredth part of the total land-area of the globe, would be as richly endowed with the new source of power as it is with coal. If the sun's beams are in the future to be the direct source of power, it is the plains of Africa or of Australia that will be the seats of industry and not this cloud-obscured Isle.

X. The conclusions we must come to on this subject are then as follows:—

1. The power of coal is extending itself and making itself more widely and deeply felt every day. It is more and more taking the place of wind, horse, or manual power, and is becoming the universal assistant.

2. We are naturally led every day to extend our consumption of so invaluable a substance, and experience shows that the more we use the more extensive are our augmentations.

3. Our consumption is already commensurable with our total supply; that is to say, we can form some notion how long our supply will endure with a stationary consumption.

4. As this consumption increases by multiplication, our national life becomes shortened, and it is apparent that the increase cannot go on very long at the present rate.

5. The moment we are forced to draw in, other nations, possessing far more extensive fields of coal compared with their annual consumption, will be enabled to approach and ultimately to pass us.

6. The exhaustion of our mines, as it will probably manifest itself within the next hundred years, will consist not in any stoppage of supplies, but an increase of cost, and the impossibility of increasing the consumption each year as at present.

XI. At some future time then, when coal will be even a more useful agent than at present, we shall stand in a position of comparative inferiority. For such a time we can best prepare ourselves, not by short-sighted restrictions on the consumption or evaporation of coal, but by freeing the nation from its burdens of debt and ignorance and pauperism. We have many great tasks to perform, which can only be undertaken with a fair hope of success when the nation is in a state of high prosperity and progress. It will be too late to think of such great undertakings when our progress is checked, and the pressure of population and the want of employment are grievously felt. It is in a period of free expansion like the present that we can alone take any effectual measures for raising appreciably the standard of education, comfort, and morality of the people; and if we do not use the abundant wealth which our coal resources now afford us to fulfil such duties, we undoubtedly misuse it.

FOREIGN SCIENCE.

Paris, May 13, 1868.

Sewage of Paris.—New process for the manufacture of sulphuric acid. —New method of preparing carbonic acid gas for mineral waters. —Academy of Sciences: Theory of electro-capillary phenomena.—Identity of artificial with natural nevrine.—New calorimeter for rapid combustions.—Laws of the transformation of para-cyanogen into cyanogen.

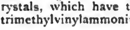
The sewage question is one which has lately attracted considerable attention in Paris; the problem, of course, has been to remove the polluted waters from the town in the most advantageous manner. The volume of these waters is now 100,000 cubic metres a day, soon it will be double this amount, and in a few years probably 500,000 to 600,000 cubic metres. We have three solutions of the difficulty. The first and most obvious is to carry the sewage into the Seine; this scheme has been well tested already, and the disadvantages seem generally more striking than the advantages. The advocates of a second plan would employ the sewage, which they would first raise by machinery to a considerable height, in the irrigation of the fields. The fertilisation of the sands at the mouth of the Thames by this means is cited in favour of the plan. The third scheme recommends itself as being the most scientific, and it is, perhaps, the best; experiments have been made with this scheme since the commencement of the spring. The sewage waters, collected in large basins, are mixed with a certain amount of sulphate of alumina—about 1 per cent to the cubic metre. Organic matters contained are rapidly precipitated, each cubic metre yielding about 3 klgrms. of solid manure. The decanted fluid, termed clear water, can be employed in the irrigation of soils, upon which it has a very fertilising action; it contains, in fact, small quantities of mineral matters in suspension, a little nitrogenous and organic matter, and the whole of the alkaline salts. The deposit obtained in the clarification is abundant and compact; it contains the whole of the phosphoric acid and nine-tenths of the nitrogenous and organic matter, and the mineral matters dissolved or in suspension; it constitutes an excellent manure, very fertilising, and easily transportable. Towns would thus be considered as manure factories, and it is believed that the value of the manure may be made to defray the expense of supplying the town with pure water.

M. Lardani has devised a new method of manufacturing sulphuric acid. The plan may be sketched as follows:—Sulphurous acid, in the presence of excess of air, is passed into dilute nitric acid, which becoming itself reduced, oxidises the sulphurous acid; the sulphuric acid, being very dense, sinks to the bottom of the reacting vessel; hyponitric acid escapes, and traversing the upper part of the apparatus, enters the regenerator, where, meeting with water and excess of oxygen, it produces nitric acid. The apparatus is composed of a furnace for burning sulphur, a washer or scrubber, a refrigerating apparatus, a reacting vessel, and a regenerator for nitric acid. The furnace in which the sulphur is burnt is traversed by a current of air obtained by a ventilator; this current, while furnishing oxygen, serves to chase out the sulphurous acid, the density of which hinders the rapid replacement of air, and thus the rapidity of combustion. Leaving the furnace, the warm sulphurous acid gas enters the scrubber, where it is freed from volatilised sulphur, and especially from arsenious acid when arsenical pyrites has been employed as the source. From this part of the apparatus the gas, passing through a pipe surrounded by cold water which condenses the water and cools the gas, becomes denser, and descends into a cascade apparatus, through which a current of weak sulphuric acid, still containing nitrous products, is made to flow. The reacting vessel into which the gas passes is composed of two parts: the lower portion contains weak sulphuric acid, upon which rests a thick stratum of nitric acid; the upper portion, separated by stoneware plates, or plates of lead or aluminium pierced with holes, contains pumice-stone saturated with water. The sulphurous acid, mixed with a powerful current of air, plunges into the fuming nitric acid, and the escaping gaseous products traversing the layers of pumice-stone, become exhausted by the time they reach the fifth receiving vessel destined to reoxidise the nitrous compounds.

M. Boudet has read a short report before the Academy of Medicine upon a new process, by means of which M. Ozouf obtains pure carbonic acid for use in the fabrication of mineral waters. At the present time the carbonic acid used in the preparation of these waters is produced by making sulphuric acid act upon marble; the calcareous carbonates, however, contain foreign substances not usually separated in the process, and the sulphuric is not completely separated in the washing. To avoid these defects, M. Ozouf has had recourse to the combustion of coke; he thus prepares pure carbonic acid. M. Boudet described at length the rather complicated apparatus employed, adding that the commission were able to testify to the excellent quality and purity of the products. The process obtained general commendation.

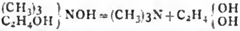
At the *séance* of the 20th of April, the following memoirs were communicated to the Academy:—"On the theory of electro-capillary phenomena, comprising endosmose, exosmose, and dialysis," by M. Becquerel; "On the identity of artificial nevrine with natural nevrine," by M. Wurtz; "A new calorimeter for rapid combustions," by M. Favre; "Laws regarding the transformation of paracyanogen into cyanogen, and the inverse transformation," by MM. Troost and Hautefeuille; "Note on the preparation of the salts of sesquioxide of iron, and on ferric chloroxide (Fe_2Cl_3,Fe_2O_3+Aq)," by M. Jeannel; "Note on the manufacture of phosphate of soda and fluoride of sodium;" "On a new acetate of chromium," by M. Schützenberger; and "On some derivatives of the radical silico-allyl." The number of papers of chemical interest is seen to be unusually large; an account of M. Wurtz's synthesis of nevrine having already appeared in this journal, an abstract of his present memoir will, doubtless, be read with interest.

M. Wurtz has obtained the chloride of nevrine extracted from the brain and the chloride of the artificial nevrine in long deliquescent needles, by dissolving the dry salt in absolute alcohol, and cautiously pouring on to the surface of the moderately concentrated solution anhydrous ether. The natural chloride of nevrine was separated from the auro-chloride by sulphuretted hydrogen, the solution filtered from sulphide of gold being evaporated, first on the water-bath, then in vacuo. The chloroplatinate of trimethyl-oxethylammonium is very soluble in water, but insoluble in alcohol. When the precipitate produced by alcohol in the aqueous solution is redissolved in water, and the solution allowed to evaporate spontaneously, magnificent clinorhombic prisms, of an orange-red colour, are obtained; crystals of regular and considerable dimensions may be obtained. Among the properties of chloride of nevrine which have been pointed out by M. Bayer, one of the most characteristic is its reduction by hydriodic acid. The oxethylic base is converted in this case into an iodethylic base. The iodide of trimethyliodethylammonium thus formed is little soluble in cold water, and is deposited in fine crystals from the boiling aqueous solution. M. Wurtz obtained abundance of this substance by reducing artificial chloride of nevrine by hydriodic acid in presence of phosphorus, at a temperature of 140°. By ebullition with water and oxide of silver, this iodide of the iodethylic base is converted into the hydrate of the corresponding vinylic base. M. Wurtz has performed this experiment upon the iodide made with artificial nevrine; M. Bæyer indicated this reaction for natural nevrine. In saturating with hydrochloric acid, the hydrate resulting from the action of oxide of silver upon this iodide, and adding chloride of gold, M. Wurtz has obtained a yellow precipitate, soluble in boiling water, and depositing, upon cooling, small crystals, which have the composition of auro-chloride of trimethylvinylammonium:—



$$\left.\begin{matrix}(CH_3)_3\\(C_2H_3)'\end{matrix}\right\}NCl+AuCl_3$$

The dilute solution of hydrate of timethyloxethylammonium (free nevrine) may be boiled without undergoing sensible decomposition; but this is not the case with concentrated solutions: they disengage trimethylamine, a reaction already indicated for natural nevrine. This is not the only product of the decomposition. When a flask, in which the solution has been completely evaporated, and in which nevrine no longer remains, is allowed to cool, a small quantity of a thick, slightly brown liquid is condensed. This body only boils at an elevated temperature; a small quantity boiling above 190°, collected, presented the characters of glycol. Heated with dry potash this body liberated, in fact, pure hydrogen; nitric acid vividly oxidised it. The formation is easily understood; hydrate of trimethyloxethylammonium, under the influence of heat, splits up into trimethylamine and glycol:—



$$\left.\begin{matrix}(CH_3)_3\\ C_2H_4OH\end{matrix}\right\}NOH = (CH_3)_3N + C_2H_4\left\{\begin{matrix}OH\\ OH\end{matrix}\right.$$

This reaction affords the first example of the formation of glycol at the expense of a natural substance.

NOTICES OF BOOKS.

The London Student. No. 1. 1868. John Churchill and Sons.

The appearance of this, the first number of a new monthly journal devoted to educational purposes, deserves a cordial welcome from all who are interested in the intellectual progress of this country. Whatever opinions may be formed as to the want of such a periodical—and it may be thought by some to be almost too serious and ambitious an undertaking to enter into successful competition with its lighter contemporaries—there can be no question that this number, from the intrinsic merit of its contents, deserves a circulation far and wide, and the most serious attention from all who are in any way connected with educational pursuits.

The work commences with a plea for more universities, by Professor Seeley, who strongly urges the advisability of a union between the London Colleges, and the consequent formation of a London University worthy of the name. "If," as Professor Seeley eloquently urges, "the British Museum is a university; if every hospital is a medical university; if the Royal Academy is a university of Art; if besides these there exist in London a number of so-called colleges, in which the fundamental condition of the university system is fulfilled—namely, that the teacher is not absorbed in teaching, but has leisure for study and research; lastly, if London is the head-quarters of all those learned societies—which are universities in the purest rudimentary form—may we not justly say that London contains the chaos of the vastest university in the world, and that little more than a word is wanting to call that university into being? These multitudinous institutions have but to unite—nay, they have but to will to unite, and the thing is done. If I may use a bold figure, London, the head of the empire, conceals behind its capacious forehead an intricate network of nerves, in the convolutions of which go on thought, observation, speculation, but no one has thought of giving a name to the mass. Let us once learn to think of it as a whole, and we shall see that it is the brain of the country."

But before the London Colleges can unite permanently they must make each other's acquaintance, and grow accustomed to each other's society, and on this point Professor Seeley writes:—

"It has long been discovered that as a cement and symbol of unity among men that have similar interests and are engaged in similar pursuits, there is nothing more useful than a magazine. The *London Student* has been projected with the view of representing the University in London both to its members and to the outer world. To the colleges themselves, both governing bodies and students, it will display the deficiencies of this great University; to the world it will display its merits. What these deficiencies and merits are, has now, I hope, been made clear. It wants unity and organisation; it possesses everything else which the age requires in a university—a vast assemblage of learned men, vast museums and libraries, variety of instruction, cheapness, absence of great endowments, a disposition to make progress and try experiments, and lastly religious comprehensiveness."

The most important paper, and certainly the one most likely to interest the readers of the Chemical News, is on "*Experimental Science the basis of General Education,*" by Professor Williamson. We make no apology for placing before our readers the following extracts from this eloquently written article:—

"If a man were entitled to a rich and glorious inheritance, of which the possession would open up to him an extensive sphere of usefulness and happiness, and if he did not claim his rights, one would naturally suspect that he was not aware of their existence, or that he had not been correctly informed of their value.

"The English people is now in the position of such a man, for it is undisputed heir to the noblest estate in the world. and has never taken possession.

"The estate is managed by trustees who reside upon it and honestly devote their whole energies to its improvement, while supplying the heir with rich and abundant produce.

"From time to time the estate is visited by friends of the heir-at-law, but a strange fascination prevents their ever returning to him. Once their feet have touched the soil, they are drawn onwards and upwards till they find themselves among the trustees, with whom they set to work improving the estate. Meanwhile the heir is living in foreign parts, satisfied with the rich produce which reaches him. Messages are sent to him to come and take possession, and enjoy the estate himself, but he heeds them not, for travellers who pass by its outskirts tell him that they do not see much in it, and that the only good thing about it is the produce which he receives.

"This unclaimed inheritance will no doubt be named when it is sufficiently known. Meanwhile we may describe it as *knowledge*:—

"Knowledge of the the most trustworthy and serviceable kind:

"Knowledge of the phenomena of nature:

"Knowledge of man's own powers and their limits, just sufficient for the purpose of obtaining more:

"Knowledge of the order of nature and of the rudiments of her laws.

"Experimental science, which is the embodiment of such knowledge, is usually associated in England with the name of Francis Bacon, who so emphatically proclaimed that its methods afford the only safe guide to the human reason in the search for truth.

"The trustees whose labours develope it in all directions are those who question nature by rational experiment, and record her answers, arranging them in intelligible order like letters into words, and learning from these words the laws of nature. These experimentalists supply man with numberless useful and agreeable products. Their numbers are constantly increased by new members, who enter upon science with the desire of seeing what it is, and are drawn on by an admiration of its beauty and harmony to become themselves workers in its domain.

"Popular writers who hover upon its outskirts describe to the world what they have seen, and the world judges science to be mainly destined as a handmaid to the industrial arts, and claims that as her highest use.

"Take as an illustration the report of the great Macaulay: he says, that 'Bacon's philosophy aimed at things altogether different from those which his predecessors had proposed to themselves;' that its object was 'to increase human comforts, to relieve more effectually the inconveniences of human life, to endow human life with new inventions and forces;' that it 'began in observations and ended in arts.'

"Again: he says that a follower of Bacon, if asked what the new philosophy has effected for mankind, would name the prominent material results which have followed from it. 'It has lengthened life, it has mitigated pain, it has extinguished diseases, it has increased the fertility of the soil, it has given new securities to the mariner,' and so forth; but not one word of teaching a better use of human reason, or of showing the true helps to the human understanding.

"So truly does this represent the commonly prevailing opinion of this country, that experimental science is almost exclusively studied by those who wish to apply it to some technical purpose; and most persons would be surprised to hear that the most important of all the applications of science is to the business of general education.

"A brewer wishes his son to learn chemistry, because he knows that the quality of beer depends upon chemical processes which can be regulated by one who understands them. A dyer values the science upon similar practical grounds. But a schoolmaster, who has to watch the direct growth of young minds, and to supply each with the food best calculated for its development, is satisfied that the knowledge of a couple of dead languages and of mathematics, fully qualifies him for the work; and while admitting the utility for technical purposes of scientific studies, he usually ignores their educational value."

. . . .

"A century has not elapsed since a discovery was made which must ever rank amongst the most remarkable achievements of philosophy. From the first dawn of human reason, the process of combustion had been an object of wonder not unmixed with awe. Men gradually learnt to obtain fire and to use it for various purposes, while the nature of the process by which it was maintained continued an impenetrable mystery to them. Various substances were found, such as wood and resin, capable of feeding a flame and of keeping it alive, but the fuel gradually disappeared whilst supporting the flame, and was supposed to be destroyed by the process. Powerful intellects strove to work out an explanation of the process of combustion, and gave words instead of facts. The process remained a complete mystery till experiment was brought to aid the reasoning powers.

"In the year 1774, Priestley obtained a gas by heating calx of mercury, as it was called. He found that combustible bodies burn in this gas with far greater intensity and brilliancy than they burn in common air; and that charcoal forms carbonic acid by burning either in air or in this gas. He declared it to be the active principle to which air owes its power of supporting combustion. We now know that combustion could not be explained without a knowledge of this gas, and that in reality Priestley's discovery supplied the key to the whole mystery.

"His mind was, however, so constituted as to discover facts by experiment, and not to discover their place in the order of nature. Priestley's energies were not devoted to explaining the process of combustion; he was a conservative in theory, and he called his wondrous gas 'Dephlogisticated air'—a name which was retained until the new theory of combustion suggested a better one.

"It was, however, not long before Lavoisier turned the discovery to account in his brilliant and masterly theory of combustion. He proved that this gas, which he named oxygen, unites with the materials of combustible bodies when they are burned in the air, and that the compounds thus formed contain the oxygen and the combustible materials.

"Combustion is a combination which gives off heat and light, but which does not destroy the elements taking part in it. If we burn wood or tallow or resin, and collect the products formed by their combustion, we can recover all the materials of the wood, or tallow, or resin, and the oxygen which had united with them.

"Those who know the wondrous light which this theory has thrown upon natural processes, and the vast amount of knowledge of the properties of transformations of matter which it has rendered accessible to us, cannot hesitate to class it among the most important results which man has yet attained.

"It enables us to understand, to classify, and to describe an infinite number of processes of change discovered by chemists; processes of which a few only have been explained in any other way at all, and those few in a most inconvenient and clumsy way.

"If we compare man's present insight into Nature (imperfect as it is), with that which he would have if this idea and its fruits were taken from him, it is like comparing daylight to the faint glimmers of starlight. We now see changes in the properties of matter which take place when different kinds come together under particular conditions, and we learn how to regulate those changes by our knowledge of their nature and conditions, where formerly our uncertain glimpses gave us confused and untrue impressions of destruction and production of different kinds of matter. We are delighted with a perception of natural forces working silently and irresistibly; and the more we observe and compare the results produced by these forces under various conditions, the more order and harmony do we find pervading the infinite variety of their manifestations.

"But while our power over matter has increased, we have become aware of its limits; for we now know that we can neither destroy nor create matter, only arrange, distribute, and alter its properties.

"Greatly as we must rejoice at these results, viewed as mere instruments of thought, they sink into comparative insignificance beside the method which led to their discovery, and which leads onwards to all future extensions of our knowledge. What made Priestley examine the properties of air itself and compare them with the properties of air in which a piece of charcoal had been burnt? What made him examine the gas given off by heating mercuric oxide or by heating nitre? He was cognisant of the facts and ideas established by previous investigators respecting combustion in air; and he put such questions to Nature as were suggested to him by a consideration of the results before him, receiving in reply facts of momentous importance. What made Lavoisier establish the theory of combustion by arranging Priestley's facts in natural order among other facts relating to combustion, and describing that order? Both men had the same materials of the thought before them, and both were interpreters of Nature; but two minds more different in their constitution could hardly have been, and two pieces of work more different than theirs can hardly be found. Priestley found the materials, but could not arrange or explain them. He could not even see the explanation when given by another. Lavoisier's chief merit was in arranging the facts given to him. He measured the amount of the changes which had been discovered, and his theory of combustion is the simplest statement of the result of a quantitative comparison of those changes. He had a genius for discovering order—Priestley had a genius for discovering isolated facts. The work of each harmonises with each other, and their very differences made them the more necessary to one another.

"Some persons might attribute this great result to chance (a common name for ignorance of causes); but those who examine carefully the course of discoveries and investigations prior to Lavoisier, will see that facts and ideas had been steadily accumulating for his theory; and that even if Priestley and he had not lived, others would doubtless have been led by the same laws of progress to make the discovery. Indeed it so happens that there lived in a little town of Sweden a quiet and modest man named Scheele, who, following quite independently the path of research, discovered oxygen nearly as soon as Priestley, and by a distinct process. Many a new truth was brought by that quiet honest man from the fountain head of knowledge, by the aid of the facts and ideas supplied by previous investigators.

"When we look back upon the work of that period, free and independent as the workers felt themselves to be, and various as were their aptitudes and peculiarities of mind, we see that in all parts of the field they were moving forward in the same direction, and helping one another by an involuntary division of labour. When we examine the work which has been done more recently, we see that the results of those great men have been used as instruments of thought by the latter workers, and gradually developed by further investigations, while new discoveries have been made and used in their turn as additional instruments of thought to extend still further our means of gaining knowledge. The first discoveries alone were within reach of the limited knowledge then available for experimental purposes, and they were needed for the latter work.

"The mind of man has only progressed and can only progress in a particular order. It must begin with the simple and rise gradually and slowly to the complex. The very attempts to deviate from this order only serve by their failure to prove its inevitable necessity.

"One other episode of modern history seems worthy of consideration. It is not many years since there existed among active chemists a difference of theory which was considered important. The difference was expressed by the words Type and Radical. Some explained compounds as built up upon types, others contended that they were built up from radicals. Each party appealed to facts which favoured its own view, but neither party paid much attention to the facts quoted by its opponents. We now know that each party was right, except in its denial of the other statement. Each theory describes truly a certain number of facts, and a more general theory includes them all. Our present theory required the study of compounds from the point of view of radicals and also from the point of view of types, and they are, as it were, legs upon which our more general theory stands."

In the second part of his paper, published in the May number of the *London Student*, Professor Williamson points out some of the educational uses of experimental science.

CORRESPONDENCE.

SCIENCE TEACHING IN SCHOOLS.

To the Editor of the Chemical News.

SIR,—The difficulty for a conscientious lecturer on experimental science, seems to me to consist in his thinking himself obliged to go on from point to point with only a little reiteration, and with no oral questioning of his hearers. Grammar probably requires more reiteration, more catechetical friction and raking, than physical science; but, to a certain extent, their demands must be similar. A teacher of grammar can do nothing without the frequent, sudden, lively interposition of questions; he cannot be satisfied that grammatical conceptions are formed in the learner's mind, except by seeing that the learner works under varied conditions. I imagine that a teacher of science ought to make sure that he is teaching, not merely by one examination at the end of a course of lectures, but by frequent catechetical examinations.

I sometimes sit amongst the young listeners to an experimental lecture: they have an infinite advantage over me in observing the experiments; but I have an equivalent advantage over them in recognising at once the terms used by the lecturer, by which they are often bewildered; and I long to stop him, and insist on his waiting till he is sure that they understand him. He assumes, I do not assume, that they at once recognise and understand such terms as "suspension," "solution," "inverse ratio," "refraction," "specific gravity."

It would be a robbery of precious time if he stopped to grind such conceptions into the minds of the ordinary boy: that is his view. Be it so: then there must be a division of labour. Let the demonstrator go on with his lecture: let the hack schoolmaster at other times teach the terminology; any cultivated man ought to be able to do this. We, who live with boys, and become, or remain like boys, know better than the lecturer knows their shoals and fogs of misconception, their power of forgetting, their innocent hypocrisy in assenting, with a look of intelligence, when they are really perplexed.

Unluckily, there are but few men who care to go over the ground that another man has ploughed, and pick out the weeds that he has left behind.

Having now and then done this for your respected correspondent, Mr. Rodwell, I recommend it as an ancillary department of that science teaching which is required of our schools.—I am, &c.,

WILLIAM JOHNSON.

Eton, May 5.

CHLOROCHROMIC ACID TEST.

To the Editor of the Chemical News.

SIR,—This test, which is implicitly asserted by some text-books and teachers to give sure and distinctive evidence respecting the presence of chlorine or a chloride, seems to me to fail in the case of $PbCl_2$, Hg_2Cl_2, and AgCl.

In operating, I powdered and intimately mixed in a dry mortar about ½ a grm. of each of these materials with double the quantity of neutral chromate of potassium; after drying the mixtures they were well moistened with strong, pure, warm H_2SO_4, when there occurred no visible evolution of any vapour, either red or yellow; the silver mixture smelled feebly of chlorine.

Hence it appears that the chlorine in an insoluble chloride may escape detection by this method, and the process will only therefore be reliable after we have replaced bases furnishing such, by others (say the alkalies) which will admit of solution in the menstruum sulphuric acid.

Since both $BaCl_2$ and $CaCl_2$ yield abundant fumes of CrO_2Cl_2 on similar treatment, it would seem that the preceding instances of the failure of the test are not due to any insolubility of the after-products; but I must leave others to theorise.

Should there be any novelty (which I can hardly imagine) or utility in this observation of a student at the threshold of the gate of science, perhaps your impartiality will lead you to communicate it to others similarly situated.—I am, &c.,

B. W. GIBSONE, M.A.

Eaton Square, May 13, 1868.

MISCELLANEOUS.

Galvanic Action of Copper-Bottomed Ships in Dock.—The *Elk*, 2, twin-screw (composite-built) gunboat, 465 tons, 120-horse power, launched during the past winter from Portsmouth Dockyard, and subsequently fitted with her engines and boilers, was placed 10 weeks since in the old shipping-basin of the yard, to wait there the finishing of her pair of screws, which were ordered to be cast from enlarged patterns. On Tuesday last she was taken out of the basin again and docked to receive her screws, which had in the meantime been completed for her. On attempting to clean the ends of the shafting, however, to receive the screws, it was discovered that galvanic action had been at work to such an extent that the "key" pieces on the shaftings were reduced to plumbago, and other parts of the metal "honeycombed." The fact appears to be that the small area of water in the old ship basin is but seldom open to the admission of the tide, has always three or four copper-bottomed vessels floating upon it, and is, therefore, a chemical bath, whose power has been so unexpectedly, yet convincingly, displayed upon the screw shafts of the *Elk*.

NOTES AND QUERIES.

Nitrate of Iron.—Can any of your readers inform me how to make a good and cheap nitrate of iron? By inserting the above in the columns of your valuable paper you will much oblige—A Constant Reader.

Preparation of Subchloride of Copper.—The directions are:—Digest 4 parts finely divided metallic copper, and 5 of common black oxide of the metal in hydrochloric acid: prolonged digestion is necessary. Regarding the above I used the proportions given, and left them to digest in an open porcelain basin, using strong hydrochloric acid; after a week the whole of the metallic copper was not dissolved. 1. Should strong acid and a wide open basin be used of digestion? 2. Should it be digested with application of heat or not? 3. When the reaction is complete, should any of the metallic copper be left if used in proportions given? 4. Is this (Mallet's) method the cheapest and best for making oxygen in large quantities, or is the chloride of lime, or the other French processes, better and cheaper?—Enquirer.

Extract of Madder.—There are met with in the trade several preparations of madder, known as garaneine, flowers or bloom of madder, garanceux, azale, and colorin; the two latter are, in a sense, extracts. Azale is obtained by exhausting flowers of madder, fleur de garance, with boiling wood-spirit (not methylated spirit, but the methyl-alcohol of commerce); the mass is put on a filter, and to the filtrate water is added, whereby a copious yellow residue is thrown down, which is washed with water, dried, and afterwards applied for dyeing. Colorin, however, is obtained from madder by exhausting it with boiling alcohol, filtration, evaporation on a water bath, when an extract will be left which contains all that is soluble of madder in alcohol; it is better to use garancine for this purpose, than madder, as it yields a better and far more pure product. If your correspondent "W. B." requires more details, he had better consult the numerous books on this subject published.—Dr. A. A.

TO CORRESPONDENTS.

Authors of Papers, desirous of having extra copies printed for their own use, are requested to communicate with the Printer, Mr. Dutton, at the Office, Boy Court, Ludgate Hill, E.C.

Messrs. Townsend and Adams, N.Y.—Mr. Horsley's address is Laboratory, Police Station, Cheltenham, England.

J. Mayer.—The report is unavoidably postponed till next week.

Natrium.—Hyposulphite of soda is made at alkali works as a by-product in the manufacture of soda. You cannot make it economically from sulphate of soda.

A. B. C.—Olive oil is sometimes adulterated with poppy, sesamé, earth-nut, or colza oil. The methods of detecting these adulterations are not very satisfactory; a good account of them is given in "Watts's Dictionary of Chemistry," under the heading "Oils."

J. Denham Smith.—A proof shall be forwarded. The letter arrived too late for insertion this week.

W. Berrie.—It is said that aniline colours may be discharged by a printing paste of powdered zinc and starch, and subsequent washing with acid.

W. B.—We can only insert your queries as an advertisement. It is not suitable for our Notes and Queries column.

A Manufacturer.—See answer to W. B.

M. A. Whichelo.—In commercial examination of tobacco, the leaf should first be examined physically and microscopically, to detect adulteration. Then examine for ammonia and nicotine. Usually an estimation of the latter alkaloid present will suffice, in addition to that of the water, ash, and total nitrogen. Consult on this subject a very good article, by F. F. Mayer, of New York, reprinted in the Chemical News, vol. xii., pp. 74-88.

Communications have been received from W. O. Reichardt; W. Chapman; G. F. Rodwell (with enclosure); M. Carmichael; C. Chateau (with enclosures); W. White; Dr. R. Angus Smith, F.R.S. (with enclosures); Walter Woodbury; J. Samueison; Dr. B. H. Paul (with enclosure); E. A. Teschemacher and J. Denham Smith (with enclosure); F. W. Brearly The Aëronautical Society of Great Britain; Dr. E. O. Röhrig; Rev. F. Sonley Johnstone; H. B. Condy (with enclosures); W. Briggs; W. Berrie; J. Mayer (with enclosure); Alfred Bird (with enclosure); Wm. Briggs; F. C. Calvert & Co., Manchester; Mawson and Swan, Newcastle-on-Tyne; W. A. Larder, Louth; Sampson Low & Co.: Dr. T. Wood (with enclosure); R. Campbell, jun., Montreal.

We are indebted to correspondents for the following periodicals, containing reports and articles of Chemical or Scientific interest:—"The Acadian Reporter;" "The Darlington and Stockton Times;" "Mining and Scientific Press;" "American Artisan;" "American Journal of Mining;" "Journal of Gas Lighting."

MEETINGS FOR THE WEEK.

Tuesday.—Royal Institution, 3. Dr. M. Foster, "On the Development of Animals."
— Pharmaceutical. Conversazione.
Wednesday.—Society of Arts, 8.
— Pharmaceutical. Annual meeting, 11.
— Geological, 8. 1. Dr. J. Schmidt, "On the Eruption of the Kaimeni of Santorin." Communicated by Sir R. I. Murchison, Bart., K.C.B., F.R.S., &c. 2. J. Prestwich, Esq., F.R.S., F.G.S., "On the Structure of the Crag-beds of Norfolk and Suffolk, with some observations on their Organic Remains.—Part II. Red Crag." 3. James Thomson, Esq., "On some Carboniferous Corals." Communicated by Dr. P. Martin Duncan, Sec. G.S., &c.
Thursday.—Royal Institution, 3. Prof. Grant, "On Astronomy."
— Chemical, 8. Dr. W. J. Russell, "On Eudiometrical Analysis." Mr. W. H. Perkin, "On the Combining Powers of Carbon."
Friday.—Royal Institution, 8. Prof. Odling, "On some effects of the Oxyhydrogen Flame."
Saturday.—Royal Institution, 3. Prof. Grant, "On Astronomy."

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3625. B. Engel, Lawrence Lane, Cheapside, London, "A new and improved composition for extracting ink and iron-mould from linen and woollen fabrics."—A communication from L. A. de L. d'Herlen, Boulogne-sur-Mer.—Petition recorded December 21, 1867.

176. E. Dorsett, London Street, London, "Improvements in the utilisation of coal tar and the products arising from the distillation thereof, and in the apparatus employed therein."—January 18, 1868.

504. J. A. Hogg, Montague Street, Edinburgh, "Improvements in the method of, and means for, increasing the combustion and illuminating power of gas."—February 15, 1868.

747. G. Davies, Serle Street, Lincoln's Inn, Middlesex, "Improvements in the manufacture of gas for lighting and heating."—A communication from L. C. E. Vial, Paris.

753. C. Schinz, Faubourg de Saverne, Strasbourg, France, "A process for the partial elimination of the nitrogen from the products of combustion and furnaces and apparatus connected therewith."—March 4, 1868.

785. J. Houston, jun., Glasgow, N.B., "Improvements in the manufacture of composite candles and in the machinery or apparatus employed therein."—March 6, 1868.

821. C. D. Abel, Southampton Buildings, Chancery Lane, "Improvements in the producttion of brown colouring matters for dyeing and printing."—A communication from J. G. A. Gros, Mulhouse, Haut Rhin, France.

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THE CHEMICAL NEWS.

Vol. XVII. No. 442.

ON SCIENCE TEACHING IN SCHOOLS.

By OSCAR BROWNING, M.A.

As the subject of the teaching of science in schools is being discussed in these columns, it may perhaps conduce to the settlement of the question if I offer a few suggestions from a practical point of view.

It will be scarcely necessary to consider the position of those who think that science should be made the basis of education. It is possible that the training of the future may take this form, which is so ably advocated by Mr. Herbert Spencer; the attempt which is being made in France to create an "enseignement secondaire special," of which the backbone is mathematics, and in which science takes precedence of literature, may offer a lesson or a warning to coming generations. But in our time the supremacy of literature is not likely to be overthrown, partly because it is probably the best training for the majority, partly because it has in its favour the prescriptions of many years, but chiefly because adequate teachers of science cannot be found. The new scheme of education in France, to which I have above referred, cannot be put into action until the Normal Schools of Cluny and Mont Masan have sent forth several generations of professors. The problem which we have to solve is, after admitting that science is ancillary and subordinate to literature in education,—to decide what science is to be taught and what means are to be used in teaching it.

There is at present great want of a recognised programme of scientific study. In founding scholarships for natural science there appears to be a great difficulty in arranging the limits and scope of the examination. The witnesses examined on this subject before the Public Schools Commission do not agree; each one asserts that his own subject is admirably fitted to be an educational instrument, but he does not attempt to define the place it should hold in a general scientific education, or the relations which it bears to its competitors. The only subject which several scientific men agree in recommending is applied mathematics. They urge the study of mechanics and hydrostatics at schools. There is scarcely a school in England where mathematics are not taught to every scholar, and there are, I should imagine, few minds which are incapable of apprehending mathematical reasoning. At Eton it is frequently found that the best classics are also the best mathematicians. There can be no reason why applied mathematics should be more difficult of apprehension than the pure science, and it would seem advisable to introduce the teaching of statics, dynamics, and hydrostatics, into all schools, treating the subjects both mathematically and experimentally, so that they may form a link between the two branches of science, and there can be no reason why these subjects should not be obligatory upon all the scholars.

After this we leave our certain ground, and are obliged to feel our way with greater caution. Various authorities have recommended the teaching at schools of botany, geology, physiology, natural history, physics (*i.e.*, heat, electricity, magnetism, &c.), and chemistry. It is obvious that if science in the whole mass is to be subordinate to literature, and if pure and applied mathematics are to be taught compulsorily to all, that the whole range of these subjects cannot be made part of the regular school course, unless they are to be taught with an unreal and delusive shallowness. We must make a selection, and the only safe principle appears to be that each of these studies is suited to a different mind, and that Nature herself indicates which is the most proper to be taught to each individual.

We cannot speak with any certainty of the processo growth in the human mind. But by careful watching we seem to arrive at the conclusion that the faculties of each mind are evolved in an order peculiar to that individual. There is nothing more capricious or inexplicable than the steps by which the full manly growth is arrived at from the size of childhood. If you take twenty boys at eleven years old, with some knowledge of their parentage, you may predict what development they will have reached at twenty-five. But you cannot indicate the steps by which this development is to be attained, or the age at which the most critical change will occur. It would seem to be the same with the mind. Experience of boys' minds tends to show me that they are not generally indolent or inactive; that if they are surrounded by healthy conditions, they are really desirous of growth and nourishment. The chief difficulty of the teacher is to discover the precise food which is required at a given time. If this is offered it is received and assimilated with the greatest ease and rapidity. The most perfect possible education would be given by supplying at the right moment the intellectual food for which the healthy mind was craving. The most astonishing results in education have been produced where very able men have given their whole thoughts to the education of very able boys. This is impossible at a public school; there must be a fixed curriculum of some kind, and this we have decided is to be literature and mathematics. But the various branches of science I have above enumerated are admirably suited to be applied as alteratives to the jaded mind, and to excite the appetite for knowledge which may have been dulled by application to the regular studies.

Sciences which possess a complex terminology are often acquired with ease by very young children. A boy whose tastes lie in that direction will learn the names of a great number of flowers and insects before he is ten years old, and in cases where this appetite for accumulating names is not directed to a useful subject it has recourse to heraldry or stamp collecting, or some similar pursuit. The existence of this power in childhood may not indicate any faults of grasping scientific truth in the mature man, but it stores the mind with facts which would be learnt far more laboriously at an advanced age. It frequently happens that a dull sluggish scholar has his mind assailable by some particular branch of science. I may mention some cases of this which have come under my notice. It would be well if schoolmasters could adopt the plan of describing their cases of education as methodically and accurately as a doctor describes his cure. In this way a mass of information might be collected which would be of the greatest service in forming a true theory of education.

A., aged 14, stupid in classics and mathematics, fond of chemistry experiments, and of mechanical contrivances. Attended a course of lectures with "Roscoe" as a text-book; answered questions on the first twelve chapters of "Roscoe;" read "Hofmann's Chemistry" with a competent teacher; begged to be allowed a chemical tutor in the holidays, and worked with him through "Conington's Analysis;" if he works well, will be fit for a foreign university in a year's time; his general intelligence has wonderfully brightened, and his love of work increased.

B., aged 14, clever in classics, fair in mathematics, generally cultivated in language and history. Studies chemistry in "Roscoe" and "Hofmann;" gives most of his time to geology in "Lyell" and "Juke," which he knows thoroughly; is well acquainted with the geology of Scotland and the Isle of Wight; spends his leisure time in arranging fossils; read "Darwin's Cruise of the Beagle" twice, and the "Origin of Species" with avidity and intelligence.

C., aged 13, very fair in classics and mathematics; has read a great number of books on entomology, which is his special study; knows "Kirby and Spence" almost by heart.

D., aged 16, very dull in the regular work; has written a good and exhaustive book on the birds of two English counties; is devoted to ornithology.

These cases are drawn from a small area, and are perfectly well known to me. In each case the study of their particular science has made them more generally bright and intelligent, but they do not show any desire to learn the sciences which lie outside the circle to which they have devoted themselves.

Now, science may be taught in three ways—1st, as a collection of facts useful to be known; 2nd, as a training of the observing and reasoning powers; and 3rd, as a means of educating those who are destined to be workers in that particular field. The first of these is not to be despised. A knowledge of leading physical facts should be a part of all education; it may help to guard against misconceptions where it does not give actual knowledge. It is best imparted by lectures; and I should believe that one or two lectures given by the very best informed men in the several subjects, would be more effectual than many lectures given by men of inferior brilliancy. A system of itinerant lectures to great schools by great men would be a powerful educational engine. Besides, it is only by these lectures that the special aptitude can be discovered or called into existence. The sight and voice of great discoverers may fertilize latent germs of kindred genius.

The second aspect of scientific study has been dwelt upon with force and eloquence by Mr. Wilson on several occasions. He has shown how the study ot science may train the mind in that which ought to be the end of all teaching, accuracy of thought and accuracy of expression. But nearly all sciences will do this equally as well, and many branches of a literal and mathematical training will do it also, and no branch of science is likely to do it effectually unless the interest and attention of the learner be first excited. It is quite true that the pursuit of truth is at present a characteristic of science, but it should also be a characteristic of theology and morals, philology, and history. Teaching has by the indolence and bigotry of mankind degenerated in many cases into the mere enouncing of ready made conclusions, which are to be accepted without question by the hearer. Science still dwells upon the heights and heathers, the pure air of divine philosphy. But is there no trace of such attachment to ascertained truths in the history of science itself? Were not the discoveries of Fresnel suppressed by older savants who feared their revolutionary character, and does not M. Duruy suspend the professor of physiology whose conscience leads him to the conclusions of materialism? The introduction of science into schools may serve to emancipate our existing teaching of other subjects; but it may also find that it has entered into the house of bondage, and in any case it is not the only study which is fitted to trace and exercise the mind for the search after pure and simple truth. The calculus of reasoning which science imparts is analogous to that of mathematics, philology, logic, or metaphysics. But I question myself if it is not a coarser and less powerful engine of thought than that by which a sheet of Thucydides is translated, or a passage of the Choephoræ restored. The third end of scientific teaching is all important. It is of the utmost moment to the country that no special talent should be lost to it. Our little army of explorers, in all branches of art, science, and literature, is not so large that it can dispense with recruits, while the adaptation of the outward circumstances of existence to the requirements of the development of the inner nature is the only means of assuring an harmonising and happy life. Every boy who is capable of receiving an education by means of any branch of physical science should have the fullest opportunity and encouragement to do so. I think I have by this time indicated the precise action which I would advocate.

1. That no exact study of science should be compulsory except that which is closely connected with mathematics.

2. That lectures should be given on all branches of science by distinguished men, for the purpose of giving useful information, and stimulating the zeal of those who are likely to devote themselves to any branch of the subject.

3. That accurate teaching in chemistry, botany, geology, natural history, and the various branches of physics not included in applied mathematics, should be provided to all who show a special aptitude and desire for the study, and that such boys should be excused so much of the school curriculum as would enable them to study the subject with profit and advantage.

I must now conclude this very hasty sketch of the kind of science teaching which I think should be provided in schools. The greatest danger which we are running in England in the matter of education is of adopting a too extended curriculum which must necessarily be shallow. They are discovering in France, Germany, and Holland, that they have made this mistake. But in these countries everything is regulated by a ministerial programme, and the only method of consulting special aptitudes is by introducing a system of bifurcation, which answers as badly abroad as it does in England. But in our great English public schools, the freedom from control among the boys, and the close and affectionate relation between the tutor and the pupil, gives scope to a liberty of learning and a liberty of teaching, which we are told is the informing spirit of the German universities. To these two great principles we ought to cling. The advocates of new studies only succeed in proving that they are good engines of education. They do not convince us that we should abandon the old studies or force the new upon all. De Tocqueville left us a warning that we should not become *polytechnise's*, as Frenchmen are. The real advance in education lies in the reverent and loving watching of each human soul, the guarding it from all influences which may confine or distort its growth, and the surrounding it with all the food it asks for the support of its daily life, that by the gradual progress of individual development it may arrive at a mature character which will find the world in which it lives in accord and harmony with its aims and aspirations. If this training were adopted by us, a public school would present a rich variety of character which philosophers think that our modern society is certain soon to lose. And in obtaining this diversity, science has to play a very important if not the chief or leading part.

Eton, May, 1868.

ON THE ESTIMATION OF POTASH.

By F. T. TESCHEMACHER & J. DENHAM SMITH.

In the Chemical News of the 24th ult., No. 438, we read, well nigh with dismay, an abstract of a memoir on "*The Estimation of Potash*," by Messrs. James Chalmers and R. R. Tatlock.

For years we had pinned our faith on the truth of the results indicated by the chloride of platinum and potassium; so clean, so exact, and so unvarying were they, with the added and vast advantage that an error in the platinum salt, unless gross indeed, affected the outcome of potash but slightly; and now we are told that this faith is naught, and that we have been blundering all our days.

May we be permitted to make some cursory remarks on the memoir in question, with the view of showing wherein we agree or differ from these chemists, of describing a process, in detail, which will yield exact results, and of the issues of some few experiments, made with the object of re-assuring ourselves, after the rude shock our belief in the platinum salt had sustained, and thus defending the true faith in this matter.

We are told that "Glasgow is the destination of almost all the muriate of potash manufactured from the interesting deposit in the vicinity of Stassfürth," &c.: a statement which, if true, would be much to the advantage of Glasgow and its chemists; but, in our present sceptical state of mind, we are curious as to the source of the saltpetre used in France, Germany, and Central Europe, if Glasgow monopolises the Stassfürth muriate; and also how it happens that both France and Germany now-a-days export refined saltpetre to this country; a manufacture, especially the German nitrate, of singular excellence often containing less than one ounce of impurity to the ton of refined saltpetre.

Our authors, on the plea that "they have made thousands of potash determinations, urge that they may fairly claim to have some acquaintance with the subject;" a claim to have been admitted, had these potash determinations been correct; but as the very gist of this memoir is that all potash estimations, necessarily including these thousands of their own, have been wrong, or at the best doubtful, such acquaintance, that of erroneous practice, must needs be worse than none at all. Several remarks now follow to show that "the general tendency is to report potash too high:" that they have found "results giving a total of 100 per cent in a muriate of potash, from potassic chloride and water alone." We presume this sentence means, that the authors have seen a certificate of an analysis of a sample of muriate of potash setting forth that water and chloride of potassium were its sole constituents, and consequently "they feel warranted in saying that serious errors were made," a statement in which we heartily agree. "They admit that such remarks may seem to involve rather strong and severe strictures on experienced analysts;" and here again we are at one with them, only we should omit the qualifying words with which they dilute their judgment, and limit our adherence to its justice, by assuming that these remarks relate to the chemists of Glasgow only; subject to which provisoes we cordially concur in all they have said in this division of their memoir, as it exactly tallies with our own experience of Glasgow estimations of potash salts.

Here we fear that our agreement with the authors of this memoir ceases for a while, for we deny, *in toto*, that the errors in question "are chiefly due to an unsuspected source of error in the reagent employed," maintaining that these errors, which, beyond question, are of constant occurrence, are due to imperfect manipulation, and to this alone. We must also deny that "the purity of the platinic chloride solution, the key-stone of their process, is requisite to ensure accuracy," and as we are not by any means certain that "crime and punishment are inseparably associated," we also are latitudinarian enough to assert that "impure platinum," at least that which our authors regard as such, "and false results," have no necessary connection, and that true and accurate results depend solely on manipulation.

We presume that these gentlemen, and Glasgow chemists generally, obtain the double salt of platinum and potassium as the bright yellow powder, the characteristic test for potash, (if so here is one source of error); we have long since found it difficult to obtain reliable results from this salt in the pulverulent condition, and possibly also they have been sparing in their platinum, another fatal error; but on these points we are left in the dark, so far as the abstract in your Journal can inform us. We gladly note the excellence and value of most of the points in manipulation described under "II.," p. 200, as part of a system we hold to be indispensable to accuracy. This brings us to our second object, that of describing in detail a process for estimating potash which will yield exact results; and here, Sir, we fear that we must trespass on your space, and possibly on the patience of your readers, as we fully share the objection these Glasgow gentlemen raise to the meagre nature of the details of analytical processes furnished in many books on chemical analysis, far preferring the extended and exhaustive descriptions of H. Rose, to the concise and bald methods, interrupted by continual references, adopted by his successors.

We assume the salt under examination to be a sample of commercial muriate of potash, or that the alkalies exist in such a condition that by the addition of hydrochloric acid in excess, they will be converted into chlorides. Like Messrs. Chalmers and Tatlock, we also take 500 grains of the salt, previously carefully ground and mixed, and dissolve it in water, filtering if requisite, and washing the insoluble portion till solution and washings measure 5000 grains. Mix this solution by pouring from one glass to another, and take 500 measured grains of this solution (we must lay stress on accurate measurement, always at one level of the eye and one level of liquid and line of measurement), and dilute these 500 grains till they measure 5000 liquid grains, and mix: 1000 measured grains of this solution contain 10 grains of the original salt.

Now, to 1000 measured grains of this solution, add excess, say 50 grains of hydrochloric acid if the alkalies are not present as chlorides, and pour into a shallow porcelain dish, making with the rinsings of the measure, &c., some 1500 grains of solution. Heat the dish and contents nearly to ebullition, and add to the hot solution so much solution of chloride of platinum as is equal to 20 grains of the metal. Evaporate this mixture on water-bath nearly to dryness; that is to the point when the thick syrupy liquid, on the momentary removal of the dish from the bath, passes into an orange-coloured pasty mass. At this point remove the dish from the bath, and at the same instant and before the dish and its contents have had time to cool, drench it with, say 500 to 600 grains, of rectified methylated spirit containing about 15 per cent of water to 85 of the alcohols; mix rapidly by imparting a rotary motion to the contents of the dish; then cover it and allow it to digest for, say 5 minutes. Have not too small a filter ready—of some 400 to 500 grains capacity—in a funnel with a cover, it will facilitate filtration by washing the filter first with hot water and then with spirit, after this short digestion pour the alcoholic solution of the platinum salts on to the filter, draining the crystalline solid scales of the potassium salt as dry as possible, and again drench, agitate, and digest the insoluble salt with spirit; repeat this a third time, when the spirit will come away nearly colourless. Now collect the light orange crystalline scales of the chloride of platinum and potassium on the filter, by means of a wash-bottle, and, if need be, wash with spirit till it passes perfectly colourless. It is very advisable to wash the platino-potassic chloride by decantation and finally by a stream of spirit from a wash-bottle, to avoid the use of stirrers so as to prevent the scales being broken down, and to keep both dish and funnel lightly covered till the washing is completed.

There is now nothing more to be done than to dry and weigh the platino-potassic salt, and to ignite and weigh the filter and add this to the weight of the salt. Owing, however, to the crystalline nature of the salt thus obtained, but a slight stain adheres to the filter, so that the loss by ignition is infinitesimal and does not affect the result. As this crystalline precipitate is not hygrometric, its weight is easily and accurately determined.

We trust that this description of the process, which we have purposely made exhaustive in its details, admits of easy comprehension by those readers who may be interested in the subject, and especially by the authors whose memoir has induced us to bring this process to your notice; but for the sake of clearness we beg permission to recapitulate its leading and important points:—

I. Dilution of solutions.

II. Use of chloride of platinum in large excess, about 20 grains of metallic platinum to 10 grains of salt examined.

III. Heating of solutions, and evaporation so conducted as to obtain the potassic salt in a crystalline scale-like condition.

IV. Evaporation on water-bath to a pasty condition—no further.

V. Drenching with spirit whilst salt and dish are hot, and instantly on removal from water-bath.

VI. Washing by decantation, and avoiding breaking down of the crystalline precipitate.

In practice, the process is a rapid one, from beginning to end requiring about two hours' less time, indeed, than was frequently expended in merely washing the dense pulverulent precipitate we denounce as liable to many sources of error.

We have little more to add besides the results of the experiments we made to reassure ourselves of the thorough trustworthiness of this mode of estimating potash.

No. I. The pure German saltpetre before referred to, yielded by the foregoing process, from 1000 measured grains of solution = 10 grs. of salt, 24·20 grs. of the double salt of platinum and potassium = 10·009 of nitrate of potash, being an error, in excess, of 1-3500th of the potassium present.

No. II. 400 grs. of the same saltpetre, 100 grs. of common salt, and 6 grs. of sulphate of magnesia were dissolved in the requisite quantity of water, an imitation of an ordinary sample of the Stasfurth muriate of potash, *quoad* the potash; two separate portions of 1000 measured grains acidified with hydrochloric acid, = 8 grs. of the potash salt, yielded respectively 19·20 and 19·30 grs. of the platinum salt = 7·941 and 7·982 of the potash salt, showing in both cases a loss of 0·059 and 0·018 respectively, instead of a gain, the mean loss in potassium being 0·0148, a result, we venture to submit, close enough for any purpose.

It so happens that our chloride of platinum is the produce of years, and from repeated use of the metal over and over again it is probably pure, or nearly so, by this time; we therefore procured some spongy platinum from Messrs. Johnson and Matthey, the source of platinum which, in Messrs Chalmer's and Tatlock's hands yielded results they characterise as an "alarming state of things, showing that ordinary spongy platinum is not in a fit state for procuring pure platinic chloride."

We dissolved this spongy platinum just as it came from the makers, without any attempt at preliminary purification, and as this solution, when of equal strength to ours, was somewhat darker and redder, it probably was not quite so pure.

This solution with 1000 grs. of No. 1 = 10 grs. of nitrate potash, duly acidified with hydrochloric acid, yielded 24·10 grs. of the platinum salt = 9·860 of nitrate of potash, being a loss instead of a gain, and the worst result of our tests; whilst 1000 grs. of No. 2 solution = 8 grs. of potash salt, yielded with this "impure" solution of platinum 19·35 grs. of platinum salt = 8·003 of potash salt, a result which should satisfy the most exacting chemist.

None of these tests were made with any special care, but were treated in the usual way we adopt and have already described for estimating potash. We must add that we take 244·20 as the equivalent of the double chloride of platinum and potassium, which we think is that of the authors of the memoir.

In conclusion, we venture to submit to the judgment of yourself and the readers of your Journal, that we have proved that the estimation of potash by means of platinum may be implicitly relied on as yielding most accurate results, provided a proper and uniform mode of manipulation be adopted; and also, that the absolute purity of the platinum solution is a non-essential, that made from the usual spongy platinum of commerce answering the purpose as well as the purest.

NESSLER'S TEST FOR AMMONIA.

We have had repeated applications for information on the subject of Nessler's test for ammonia. This is frequently referred to, but always in a way that assumes a knowledge of its details. We shall perhaps best consult the wishes of a large number of the readers of the Chemical News if we condense here the best descriptions hitherto published of this test. We take the following from two papers: one published by Professor W. A. Miller, in the *Journal of the Chemical Society* for May, 1865, and the other published by Professor Frankland and Mr. Armstrong, in the *Journal of the Chemical Society* for March, 1868. In each instance the authors recommend Mr. Hadow's modification of the Nessler test. Professor Miller writes:—

"Make a concentrated solution of an ounce or more of corrosive sublimate; having dissolved 2½ ounces of potassic iodide in about 10 ounces of water, add to this the mercurial solution until the iodide of mercury ceases to be dissolved on agitation; next dissolve 6 ounces of solid hydrate of potash in its own weight of water, and add it gradually to the iodised mercurial solution, stirring whilst the mixture is being made; then dilute the liquid with distilled water till it measures one quart. When first prepared it usually has a brown colour of greater or less intensity, owing to the presence of a little ammonia; but if set aside for a day or two it becomes clear and nearly colourless; the clear liquid may then be decanted for use. For a litre of the test liquid of equal strength 62·5 grammes of potassic iodide, and 150 grammes of solid caustic potash will be required. About 50 grains (3 c.c.) of this solution are drawn off by a marked pipette and added to one half of the distillate;* if no ammonia be present the mixture remains colourless, but if ammonia be present the liquid will assume a yellowish tinge of greater or less intensity. The liquid will remain clear if the ammonia do not exceed 1-200th of a grain in the 5 ounces, or about 0·25 mgm. in 125 grammes of the distillate. The quantity of ammonia in such a case may be very accurately estimated in the following manner:—A solution of sal-ammoniac is prepared containing 3·17 grains of the salt in 10,000 grains of water (or 0·317 grammes of salt per litre), which is equivalent to 1-10,000th of a grain of ammonia (H_3N) in each grain of this solution, or 0·1 gramme in 1 litre. Suppose that a tint is obtained in the distilled liquid which experience leads the observer to estimate say at 5-1000ths of a grain; 50 grains of the standard sal-ammoniac solution are placed in a beaker similar in size to that used for the distillate under trial, then diluted with 5 ounces of distilled water previously ascertained to be free from ammonia (an impurity not unfrequently met with in the first portions of water which come over in distillation); lastly, 50 grains of the mercurial test liquor are added.

"If the tint coincides in intensity with that furnished by the distillate which has received an equal quantity of the mercurial test, the amount of ammonia may be considered to correspond with that taken in the liquid for comparison. If the distillate appear to have a deeper or a paler tint, a second approximative trial with a larger or a smaller quantity of sal-ammoniac must be made, and so on until the operator is satisfied that the tints coincide. On multiplying the number of grains of sal-ammoniac solution employed by 8, the product will give in 10,000ths of a grain the quantity of ammonia per gallon in the water under examination. Suppose that the observer estimates the amount of ammonia in the 125 c.c. on which he is operating, at 0·25 mgm., he takes 2·5 c.c. of the sal-ammoniac solution, and dilutes it with distilled water to 125 c.c.; he then adds 3 c.c. of the mercurial liquor, and compares it with the tint produced in the distillate by a like addition of the mercurial test. If the two tints correspond multiply by 2 the number of c.c. of sal-ammoniac solution required, and the number obtained will give the proportion of ammonia per litre in tenths of a milligramme. When the quantity of ammonia exceeds the 20th of a grain per gallon, or 0·6 mgm. per litre, it is necessary to determine the amount by neutralisation."

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* The author is here referring to an operation described in a previous part of his paper, in which a distillate is obtained in which is present all the ammonia which is required to be estimated.

The description given by Messrs. Frankland and Armstrong is as follows:—

"Unless the amount of ammonia obtained by distillation alone, or with sodic carbonate, be considerable (about ·01 part in 100,000 parts of water), Hadow's modification of Nessler's process is all that could be desired for its accurate determination. But if a larger proportion than this be obtained, the presence of urea [in a potable water] may be suspected, and it becomes necessary to make the Nessler ammonia test directly in the original water without the intervention of distillation. For this purpose, however, the water should be colourless, and free from calcic and magnesic carbonates. Any tint which is appreciable in a stratum 6 or 8 inches thick would obviously vitiate the result of a colour-test, whilst if calcic or magnesic carbonate be present, the addition of the Nessler solution will infallibly produce turbidity; moreover, we find that the slightest opalescence in the water, under these circumstances, is absolutely incompatible with an accurate determination. Both these difficulties might be effectually removed by adding to the water, first, a few drops either of ferric chloride or aluminic chloride in solution, and then a few drops of a solution of sodic carbonate, so as to precipitate ferric hydrate or aluminic hydrate. The precipitate completely decolourises the water, and no turbidity is caused by the subsequent addition of the Nessler solution; but, unfortunately, the precipitate carries down with it an amount of ammonia which, in the case of the ferric hydrate, sometimes amounts to one-third of the total quantity present. Remembering the beautiful blue-green tint—the natural colour of absolutely pure water—which is presented by a reservoir of water that has been softened by Clark's process, we tried upon peaty water the effect of precipitating in it calcic carbonate, and found that the decolourisation was as complete as could be desired, and that no appreciable amount of ammonia was carried down with the precipitate. The amount of calcic carbonate present in a coloured water is rarely sufficient to enable the operator to carry out this reaction with sufficient rapidity and completeness; it is therefore best in all cases to add a few drops of a concentrated solution of calcic chloride to half a litre of the water. The subsequent addition of a slight excess of sodic carbonate then produces a copious precipitate of calcic carbonate, which should be allowed to subside for half an hour before filtration. 100 c.c. of the filtrate is a convenient quantity to take for the direct Nessler determination of ammonia. To this volume of the filtrate 1 c.c. of the Nessler solution is added, and the colour observed in the usual way. [*See* Professor Miller's paper, quoted above.] By this direct process, the ammonia in fresh urine can be readily estimated; for this purpose 5 c.c. of the urine should be diluted with 95 c.c. of water free from ammonia. We have ascertained that known quantities of ammonia, added in the form of ammonic chloride to urine, can be determined with great accuracy.

"The colour observations of the Nessler determination are best made in narrow glass cylinders, of such a diameter that 100 c.c. of the water to be tested form a stratum about 7 inches deep. The depth of tint is best observed by placing these cylinders upon a sheet of white paper near a window, and looking at the *surface* of the liquid obliquely."

It would be a great advantage to all who are engaged in the analysis of waters if gentlemen who have been in the habit of employing Nessler's test, and have by experience learnt useful modifications in its application, would communicate them for insertion in our columns.

RESEARCHES ON DI-METHYL.*

By W. H. DARLING,
Dalton Scholar in the Laboratory of Owens College.

The synthesis of carbon compounds forms perhaps the most important and interesting branch of modern chemical enquiry. The most recent developments of these synthetical processes are the now well ascertained facts of the dependence of the chemical properties of the molecule, upon the position of the individual atoms of which that molecule is built up.

Any isomeric modifications of the saturated monovalent compounds containing one or two atoms of carbon can only be explained by the existence of a difference between the four combining powers of each carbon atom, whilst in the tri-carbon and higher series isomerism indicates the difference in the power of combination existing between the end and the middle carbon atoms of the chain.

From Frankland's original observations concerning the difference between the action of chlorine on the so-called di-methyl—

$$\left.\begin{matrix}CH_3\\CH_3\end{matrix}\right\}$$

obtained by the electrolysis of an alkaline acetate, and on the hydride of ethyl—

$$\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}$$

obtained from ethyl compounds, the existence of a difference in the four combining powers of a carbon atom was rendered probable.

The subsequent researches of Schorlemmer have, however, proved that only one hydrocarbon of the formula C_2H_6 exists, inasmuch as he succeeded in preparing ethyl chloride from the hydrocarbon di-methyl—

$$\left.\begin{matrix}CH_3\\CH_3\end{matrix}\right\}$$

obtained by the electrolytic decomposition of an alkaline acetate (*Proc. R. Soc.*, xiii., 225); as well as from ethyl hydride, obtained from ethyl compounds.—(*J. Chem. Soc.* N.S., ii. 262.)

It appeared of great interest to repeat this synthesis, and to prepare the chloride in larger quantity, from which to prepare ethyl compounds and ascertain their chemical and physical properties.

At the request of Mr. Schorlemmer, I undertook this investigation. I take this opportunity to express my thanks to that gentleman, and also to Professor Roscoe for the kind assistance rendered to me throughout this research.

I prepared the di-methyl by the electrolytic decomposition of acetate of potash, according to the process described by Kolbe. The gas, evolved from a platinum plate contained in a porous cell, was passed first through a solution of caustic potash, to absorb the carbonic acid, afterwards through nordhausen acid, and over pumice-stone moistened with oil of vitriol, to free it from a trace of oxide of methyl or hydrocarbon absorbable by this acid, and finally through a solution of caustic potash, to absorb acid fumes, any carbonic acid which had escaped the first wash bottle, or traces of sulphurous acid. The gas thus prepared had a very slight odour, it burnt with a non-luminous flame.

The following analysis of it is according to Bunsen's method:—

	Volume.	Pressure.	Tempt. C.	Volume at 0° C. and 1m. Pressure.
(1.) Original volume of Gas	183·48	0·1402	8·5	24·94
(2.) After addition of oxygen	333·41	0·3919	8·5	127·00
(3.) " " air	567·52	0·5221	8·5	287·5
(4.) " explosion	505·38	0·4591	9·2	224·7
(5.) " absorption of carbonic acid (dry)	447·58	0·4156	12·3	173·9

Contraction observed.................. 62·80....calculated 62·35
Carbonic acid " .... 50·80.... " 49·83
Hydrogen in two volumes of gas found 6·076....calculated 6·000
Carbon " " 2·036.... " 2·000

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* Communicated to the Man. Lit. and Phil. Soc. by Professor H. E. Roscoe, Ph. D., F.R.S.

This gas, treated with an equal volume of chlorine, was exposed to the diffused sun-light, after allowing time for the two gases to mix until nearly colourless, and completed by means of direct sun-light when quite colourless. The bottle was opened under warm water; the hydrochloric acid was absorbed equal to half the capacity of the bottle. The remainder of the gaseous contents not absorbed were displaced by warm water into a receiver, in which a few pieces of stick potash were placed, surrounded by a freezing mixture of salt and ice—a colourless, volatile liquid was condensed.* One hundred grammes of chloride were prepared by the repetition of this process. This first product was separated by distillation into two parts, one which distilled below 30° C., and the other above 30° C. On still further fractionating the first distillate, a portion was obtained boiling at 11—13° C., whose sp. gr. was 0·9253 at 0° C. Pierre found the specific gravity of ethyl chloride to be 0·9241 at the same temperature.

The chloride boiling below 30° C. gave on heating in sealed tubes with acetate of potash and glacial acetic acid to a temperature of 130°—140° C. for three or four hours, a volatile fragrant liquid, having the characteristic odour of acetic ether, which after drying over chloride of calcium and magnesia, boiled at 74·00—75·5° C. Kopp gives the boiling point of ethyl acetate at 74·3 under a pressure of 760 mm. of mercury.

In order to prepare the alcohol, the acetate was heated with crystals of baryta hydrate in sealed tubes for one or two hours, to a temperature of 120° C.; after cooling it was distilled, and the distillate treated with dry carbonate of potash until it separated into two layers, the upper one was decanted upon fused carbonate, afterwards upon anhydrous baryta, from which it was distilled, when it had assumed a light amber colour. It began to boil at 78·1°, the whole coming over before the temperature exceeded 79·0° C. Kopp gives the boiling point of ethyl alcohol prepared by fermentation at 78·4° C. under a pressure of 760 mm. mercury, and the specific gravity at 0° C. as 0·8095; calculating by means of his coefficient of expansion the sp. gr. at 6° C. would be 0·80446, whilst I found the same to be 0·80302 at the same temperature.

The alcohol thus prepared had very little odour, agreeing in this respect with the observation of Meudelejeff (*Zeitschrift Chemie*, 1865, 257), though the specific gravity is slightly higher than his at the the same temperature calculated from his coefficient of expansion, viz, 0·80123.

On submitting this liquid to combustion analysis the following numbers were obtained.

No. 1. 0·2834 grm, of liquid gave 0·5357 grm. of carbonic acid, and 0·3314 grm. of water.

No. 2. 0·5533 grm. of liquid gave 1·0481 grm. of carbonic acid, and 0·6480 grm. of water.

	Percentage		Calculated from the
	No 1.	No. 2.	formula C2H6O.
C	51·56	51·65	52·17
H	12·99	13·02	13·04
O	35·45	35·33	34·00
	100·00	100·00	100·00

The numbers are not all that could be desired when compared with the calculated, this is owing to the difficulty in burning so volatile a liquid, and to the small quantities taken. Dumas and Boullay (*Ann. de Chimie*, 1827, 36, 299) state that in order to obtain agreeing results upwards of a grm. of liquid was necessary, in one combustion 1·742 grms. were used; with ether a still greater quantity was required.

The alcohol still remaining in the carbonate of potash, and in the dilute solution was separated by distillation, this distillate was oxidised by a mixture of bichromate of potash and sulphuric acid, when the characteristic odour of aldehyde was recognised, the oxidation was continued until it had disappeared, on distilling to dryness an acid distillate was obtained, this was neutralised with pure carbonate of soda, and yielded on evaporation needle-shaped crystals of acetate of soda; the mother liquor was distilled to dryness with sulphuric acid, the distillate neutralised with pure carbonate of silver, filtered and boiled, on cooling it yielded colourless transparent flat needles, which, after drying over sulphuric acid, gave on analysis the following numbers.

No. 1. 0·4142 grm. of salt gave 0·2663 grm. of metallic silver.

No. 2. 0·5095 grm. of salt gave 0·3274 grm. of metallic silver.

No. 3. 0·3650 grm. of salt gave, after drying at 100° C. in a water bath for one hour, 0·2349 grm. of metallic silver.

No. 4. 0·2483 grm. of salt gave, after drying at 100° C. in a water bath for two days, 0·1604 grm. of metallic silver.

Estimation No. 1 gave 64·30 per cent of silver.
,, No. 2 ,, 64·25 ,,
,, No. 3 ,, 64·36 ,,
,, No. 4 ,, 64·60 ,,

Calculated from the formula of acetate of silver

$$\left.\begin{matrix} C_2H_3O \\ Ag. \end{matrix}\right\} O$$

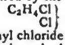
yields 64·68 per cent of silver.

That portion of the mixed chlorides which distilled above 30 C. was fractionated, when two-thirds of the total volume distilled over between 57°—59° C. The specific gravity was found to be 1·198 at 6.5° C. Regnault found the sp. gr. to be 1·174 at 17° C. and the boiling point to be 64° C. (*Ann. Ch. Phys.* [2] lxxi. 355)* Submitted to analysis the following numbers were obtained.

No. 1. 0·5206 grm. gave 0·3691 grm of chlorine.
No. 2. 0.4491 ,, ,, 0·3186 ,, ,,
No. 3. 0·4292 ,, ,, after drying over stick potash for a week, 0·3010 grm. of chlorine.

Percentage of chlorine found by No. 1, 70·89
,, ,, ,, ,, No. 2, 70·94
,, ,, ,, ,, No. 3, 71·76

The percentage required by the formula—



$$\left.\begin{matrix} C_2H_4Cl \\ Cl \end{matrix}\right\}$$

of monochlorinated ethyl chloride is 71·73.

Hence the mono-chlorinated ethyl chloride was formed in quantity by the action of excess of chlorine on di-methyl.

Having commenced the examination of the di-methyl obtained, 1st, by Frankland's method from iodide of methyl and zinc, and 2nd, by Schützenberger's process, I hope to communicate the results to the Society.

Cabalistic Formulæ.—In a scientific contemporary published abroad, the following cabalistic equations occur in the description of some improvements which have been patented by Prof. E. N. Horsford, of Cambridge, Massachusetts. 3 Cal. Po_5 + 2 [Ho, no_5] = Cal. 2 Ho. Po_5 + 2 [Cal. no_5] and again: Cal. 2 Ho. Po_5 + 2 [Cal. no_5] + 2 [Ho. So_3] + 4 Ho = 2 [Cal. So_3, 2 Ho] + 2 [Ho. no_5] + Cal, Ho. Po_5.

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* If the gas or the chlorine was not pure, being mixed with air, very little or no liquid was condensed, being carried off by the current The same was observed by Mr. Schorlemmer. This will probably account for Frankland's observation that no liquid was condensed at −18° C.

* Beilstein (*Ann. Chem. Pharm.* v. 113—110) has shown that monochlorinated ethyl chloride, and chloride of ethyleden, obtained by action on aldehyde with perchloride of phosphorus, are identical, the boiling point of the latter as observed by Wurtz is 58—59° and the specific gravity as determined by Geuther is 1·189 at 4·3° C.; these numbers agree with those I found. Beilstein remarks that the higher boiling point as observed by Regnault would result from the presence of higher chlorinated products.

PROCEEDINGS OF SOCIETIES.

PHILOSOPHICAL SOCIETY OF GLASGOW.

Chemical Section, 4th May, 1868.

Alexander Whitelaw, Esq., Treasurer, in the Chair.

At this, the last meeting for the session, a paper was read by Dr. Wallace, F.R.S.E., F.C.S., analytical chemist, on "*The Animal Charcoal used in Sugar Refining.*"

Dr. Wallace stated that his communication to the Section was not to be dignified by the name of a research, but as his name had been associated with the chemistry of sugar-refining during the last ten years, he thought it likely that as a result of his observations and experiments he might be able to mention some things not contained in books. He stated briefly the mode of making animal charcoal from bones, and mentioned the principal Scottish manufacturers of the substance. All the bone char made in Glasgow, Paisley, and Greenock, in addition to a large quantity imported from France and Russia, is used in the Clyde refineries. A large amount of it is manufactured; for notwithstanding the fact that the charcoal lasts a considerable time, it has to be occasionally renewed, owing to the stock gradually dwindling down from various causes. The author calculates that the quantity of animal charcoal in actual use in the Clyde refineries is probably well nigh 5,000 tons, and that the annual renewal is probably about 1,500 tons.

The carbonisation of the bones is usually continued for twelve hours, that length of time generally giving better charcoal than when the bones are only carbonised for six hours, even though in the latter case the heat is made stronger. After the bones are charred they are crushed between rollers, and the charcoal is ready for use when the dust is removed. The quality of the char varies with the kind of bones employed, and the care observed in the charring operation. Hand-picked home-collected bones make the best charcoal. Besides these there are the shank bones from the *saladeras* of Brazil and Buenos Ayres; camp bones dug up from old battle fields, and bearing evidence of having been buried for a long time, and the charcoal from which may be easily distinguished from that prepared from home-collected bones; and there are also large shipments from Italy and Turkey, including the bones of the camel along with those of cattle, antelopes, sheep, and horses.

In the analysis of the best charcoal from home-collected bones, carbon usually occurs to the extent of about ten per cent, the remainder being the phosphates and other mineral ingredients of the natural bones. The carbon varies with the amount of grease and gelatin left in the bones after boiling, and it also varies in the different parts of the same bone,—the hard exterior containing less than the extremities and spongy interior of the bone. Charcoal as met with in commerce usually contains about ten per cent of water, as water is used to cool the char as it is drawn from the retorts.

The author then stated generally the method of conducting the analysis. It presents certain difficulties notwithstanding the apparent simplicity of the composition of bone charcoal. He instanced carbonic acid as offering some difficulty, and said that his own method of estimating it was less complicated than the one given by Fresenius, although the latter is otherwise equally good. The method used by some chemists of precipitating the phosphate of lime, and then throwing down the lime in the filtrate in the usual way, be characterised as giving entirely fallacious results. Free lime has been occasionally found by the author, but only in minute quantity. Before estimating the carbonic acid the finely pulverised charcoal should be treated with solution of carbonate of ammonia.

Chemists have long been aware of the presence of nitrogen in animal charcoal, but the custom hitherto has been to include it in the carbon. Dr. Wallace finds it to vary in amount, and to diminish in quantity as the char is used. He found it to be 1·55 per cent in a total of 8·5 of so-called carbonaceous matter in char made from home-collected bones; and in another sample made from foreign bones it was 1·08 out of 9 parts of carbonaceous matter. Two samples of moderately old charcoal gave respectively ·3 and ·55 of nitrogen, while the carbon was reported at 15 and 17, respectively. The author did not venture to say whether or not the nitrogen plays any important part in the decolourising action, although, he said, no really good decolourising agent exists that is not made from an animal substance. It is not enough that the charcoal should be porous, for wood charcoal is so, and yet it is practically useless as a decolouriser.

Traces of ammonia always exist in new char, but the amount is so minute that the author has never estimated it. Frequently, however, it exists in the form of sulphide of ammonium, a compound which greatly damages sugar run through it. Such char should be well washed and reburned before being used. The washing removes common salt, ammonia, and the sulphide of calcium which is likely to be present if the char has been overburnt. The last-mentioned substance is due to the decomposition of the sulphate of lime, and acts injuriously on the sugar. Sulphuretted hydrogen is also given off from overburnt charcoal when treated with water or acid. A sample of new char gave ·08 per cent of sulphuretted hydrogen on treating it with hydrochloric acid. Combustible gases are frequently given off by both old and new char, and sometimes they form explosive mixtures with the air of the cisterns.

Speaking of the mechanical properties of animal charcoal, Dr. Wallace said that he had long regarded the bulk occupied by the char as compared with its weight as a property of great importance. He stated that a ton of new and dry char fills a space of about 48 or 50 cubic feet, while a ton of old char may fill no more space than 40, 35, 30, or even 28 cubic feet, the apparent density of dry charcoal thus becoming sometimes nearly double what it was. But the absolute specific gravity of old and new charcoal varies but very slightly. That the charcoal rapidly diminishes in bulk while the real gravity remains practically unaltered is a point of great importance, and one to which the author thinks he was the first to direct the attention of sugar refiners. The inference is that by frequent re-heating, the particles of charcoal become smaller owing to the diminution of the pores; hence the apparent gravity of char gives a ready and certain indication of its value in sugar refining. From experiments made by Dr. Wallace, a specimen of new char lost as much of its porosity by burning in a covered crucible during eleven hours as it would have lost by re-burning about one hundred times in a sugar-house. He is of opinion that the porosity of the charcoal is diminished by a sort of agglutination of the particles of phosphate of lime during the re-heating. New charcoal will hold from 80 to 100 per cent of water, and is made perceptibly wet with 20 per cent of water, while old charcoal (two or three years in use) will only hold from 30 to 45 per cent, and is made perceptibly wet with only 5 per cent of water. These facts prove that the pores become either smaller or less numerous as the charcoal is used, and point to the conclusion that, to keep animal charcoal in the most efficient state, it should be re-burned in such a way as to lessen the porosity as little as possible.

Dr. Wallace finds that although the action of heat is the main cause, it is not the only one concerned in producing an increase in the apparent gravity of the charcoal. The proportion of carbon may increase during use from 8 or 9 per cent, to 14, 15, or even 19 per cent,—this increase being derived from the organic impurities in the sugar. The carbon obtained in the carbonisation of these impurities is deposited partly on the surface, but largely also in the pores. This is found to be a great evil, and a great point is gained if it can be prevented. That it can be prevented is proved by the fact that in some refineries the amount of carbon does not increase, while in others it even decreases, but this is owing to mismanagement in the re-heating. When the retorts are quite tight, and the heat not excessive, the carbon necessarily increases if the precaution be not taken to wash well before re-burning, so as to remove all the organic matter absorbed from the sugar liquor. To do this, boiling water is requisite, and one of the most advanced of the Clyde sugar-refiners insists that *the charcoal should even be boiled with the water.* The author's experience accords with that of the sugar-refiner referred to.

In ordinary cane sugars there is from ½ to 1 per cent of soluble mineral matter, consisting of salts of potash, soda, lime, and magnesia; and in beet sugars there is much more—from 1½ to 3 per cent, and sometimes as much as 6 or 7 per cent. The highly soluble salts, such as the salts of potash, do not affect the charcoal, and only annoy the refiner by accumulating in the syrups; but the sulphate of lime is detrimental, owing to its comparative insolubility, and to the fact that it is readily absorbed from the sugar liquor by the charcoal. It may be removed, however, by copious washing and boiling, and it is even removed in solution by washing with weak sugar liquors. Such charcoal is sure to have its sulphate of lime increased if it be washed with water naturally containing that substance in large quantity. The author stated that he had analysed charcoal containing 2½ per cent of the salt, and that the usual amount in old char is from ½ to ¾ per cent, but that in extreme cases it may be present in Clyde charcoal to the extent of 1 per cent. The carbonate of lime present in some hard waters is also absorbed by the charcoal.

The author briefly considered the offices fulfilled by the various ingredients of the charcoal. Animal charcoal has great power of absorbing gases, colouring matters, and such mineral salts as are but slightly soluble in water. The removal of colouring matter is the chief object in view; but gummy and other extractive matters have also to be removed. Animal charcoal extracts them both with equal facility. The author finds that it readily absorbs ordinary egg albumen and gum, and he thinks that the circumstance that each of these bodies has an insoluble modification may have something to do with their absorption by the charcoal. Iron is readily removed from sugar liquors by passing them through a cistern of new char. It is the nitrogenous carbon which is the most powerful decolourising ingredient of the char, for if the char be burnt perfectly white, on the surface and without, it does not remove the slightest trace of colouring matter. This fact the author has demonstrated by actual experiment: it is with him no mere opinion.

The highly porous carbon is not the only useful ingredient, although it is essentially the decolourising agent. Carbonate of lime is also of use in neutralising the small proportion of free acid present in almost all sugars except beet; and it is still more important in neutralising the lactic and other acids formed in the weak liquors, by a process of fermentation which it is difficult to prevent. Hence charcoal deprived of its carbonate of lime is objectionable, and its use is certain to produce sour liquors and give rise to the presence of iron in the low-class sugars. As the water of Greenock and Glasgow contains only traces of carbonate of lime, the quantity of that salt naturally present in charcoal gradually lessens, until in pretty old char it is sometimes reduced to about 1½ per cent. In refineries conducted on scientific principles the amount is never suffered to fall so low. If it falls below 2½ per cent, sour liquors are sure to follow. When very hard water is used the carbonate of lime either decreases very slightly or it increases, and sometimes even to an alarming extent, as in the continental beet refineries, where the evil is a very serious one.

Dr. Wallace referred to the various methods—especially those of Beanes and Gordon—for getting rid of any excess of carbonate of lime in the charcoal; and then spoke of the inconvenience attending the use of animal charcoal in sugar-refining, owing to its oxidising influence upon the organic matters extracted by the char from the sugar, and to the alteration of the nitrogenous compounds by means of which fermentation is induced, and ultimately organic acids are formed at the expense of the sugar. These acids make the washings sour and putrid, and a necessary and evil result of that is that they decompose sulphide of calcium or sulphide of iron in the charcoal, and dissolve carbonate and sulphate of lime and oxide of iron; then, as the washings are either thrown back amongst the other products of the refinery, or mixed with a fresh lot of raw sugar, they occasionally cause an immense amount of mischief. The author said that, owing to its importance, this department of sugar refining had occupied a good deal of his attention, and he claimed to have made known to refiners the means of entirely preventing such injurious results as those referred to. His method is as follows:—While the liquor is on, the char cisterns are kept at a temperature of at least 150° Fahr., so long as the liquor is strong, to prevent fermentation. Then the water used for washing down the sugar is to run on quite boiling, and this is done with all the washings which are to be preserved. When these directions are attended to, there is no difficulty with sour washings, or with the presence of iron in the low-class sugars. The char should ultimately be washed with boiling water for 10 or 12 hours, or even boiled with it.

The author concluded with a detailed account of the modes of re-burning charcoal, and of the good and bad qualities of the different kinds of re-burners now in use, and suggested the directions in which improvements might be made.

An interesting discussion followed, and various questions were asked and answered in reference to the condition in which the nitrogen exists in the charcoal, and in reference to the use of blood and clay, soot and clay, and gluten charcoal, in sugar refining.

On the motion of the Chairman, a hearty vote of thanks was accorded to Dr. Wallace.

ROYAL DUBLIN SOCIETY.

May 4th, 1868.

Dr. J. M. Barry read a paper "*On the Physical Geography of the Southern Ocean.*" The cause of the calms, trade winds, &c., was discussed. Dr. Barry concluded his paper with some remarks on the magnetic phenomena of the Southern Hemisphere. The point of least intensity on the globe was stated to be in the middle of the South Atlantic.

Mr. Walter G. Smith, M.B., then read an exhaustive paper upon the subject of "*A Black Wax that was Imported from Madras in the year 1862.*" (The specimen is at present in the Museum of Materia Medica, Trinity College, Dublin.) The cake consists of two distinct layers—the upper one of a jet black colour, and its recent fractured surface being somewhat conchoidal; the lower layer is browner, with a granular fracture. The cut surface exhibits a waxy lustre. The specific gravity of the upper layer is 0·985, a somewhat higher density than that of bees-wax, which averages 0·96, and the specific gravity of the thinner brown layer is 1·462. The fusing point of the black portion is about 148° F., or nearly the same as that of ordinary wax. Very little could be said as regards its natural history, but the author concluded, from reasons that he gave, that it owed its origin to a particular species of bee. No mention is made of any similar substance in any of the modern works, except an early volume of the *Pharmaceutical Journal* (vol. xii., 1853, p. 401). There is an allusion in that book to a curious wax which had been imported from Brazil, the product of a black bee which lived under ground. It was soft and exceedingly tenacious, and of a dark mahogany colour.

The following is the *modus operandi* by which the anthor examined this wax :—

3·009 grains were exhausted with boiling rectified spirit, filtered and washed. The dark brown residue left undissolved by the alcohol was treated frequently with ether, and filtered. On the spontaneous evaporation of the ether, a brown colouring matter remained. This colouring matter was easily soluble in bisulphide of carbon, in benzol, and in chloroform, and when heated with hydrate of potash, turned black and evolved ammonia. It fused very readily, and did not appear to be acted upon by a strong alcoholic solution of potash. The black substance insoluble in the ether was digested with chloroform, which immediately formed with it an opaque, treacly fluid.

This substance also evolved ammonia when heated with caustic alkali.

The first alcoholic filtrate was concentrated to a small bulk, and cooled, to allow the cerotic acid to deposit. The precipitated acid was then filtered off. The cold alcoholic solution was evaporated to dryness, and the residual cerolein weighed. The results of the analysis are as follows :—

	Black wax.	Bees-wax.
Myricin	—	73
Cerolein	15·054	5
Cerotic acid	63·602	22
Colouring matter insoluble in ether	17·088	—
Ditto soluble in ether	4·253	—
	99·997	

The identity of the cerolein with that obtained from bees-wax is shown by its being acid to litmus paper, fusible at a very low temperature, soluble in ether, and quickly purified by a hot alcoholic solution of potash.

The percentage amounts of cerolein and of cerotic acid are each about three times as great as in bees-wax, but the proportion of cerotic acid varies in different samples of wax. (It was entirely wanting in a specimen of Ceylon wax, and in a wax made by wild bees in Surrey.—Brodie.)

The myricin, *i.e.*, the portion insoluble in alcohol, and which constitutes nearly three-fourths of the weight of common wax, seemed to be replaced by the two brown colouring matters.

The author does not state if the wax is capable of being practically bleached.

FOREIGN SCIENCE.

PARIS, MAY 20, 1868.

Crystallisation of Sulphur.—Production of Paracyanogen and its transformation into Cyanogen.—Manufacture of Phosphate of Soda and Fluoride of Sodium.—A Sulphur Shower.—Academy of Sciences.—Association of the Incandescence of Magnesia to that of the Carbons in the voltaic arc.

An interesting experiment has been made by M. Schützenberger upon the crystallisation of sulphur. He filled a mattrass of a capacity of 150 or 200 grammes, with refined sulphur, commercially pure, so that when fused the liquid occupied the whole of the space below the neck; the upper part of the neck was drawn out into a capillary tube which was twisted several times but left freely open to the atmosphere. The sulphur being melted in a bath of oil heated to 120°, the flask was placed in water heated to 95°. In these conditions, the sulphur remains perfectly fluid for hours, even when occasionally moved and drawn out of the hot water. If the temperature be made to fall very slowly, transparent crystals possessing the same density as the melted sulphur form either on the surface or in the midst of the fluid at about 90°. The mass of crystals gradually augments, but with great slowness; sometimes they are isolatd, at others united in groups of two, three, four, &c. The amount of crystals being considered sufficient to separate them, the mattrass is sharply inverted, so as to cool and solidify the melted sulphur in the neck. Thus the crystals are separated from the rest of the sulphur, and only remain suspended by their peaks. They are transparent and remain so indefinitely; in form they are octahedral and bear close resemblance to natural crystals. Measurement of the angles has confirmed their identity. The experiment is surer when two or three drops of sulphide of carbon are added to the sulphur before fusion, the phenomenon takes place, however, independently of this admixture. The results are similar to those of M. Pasteur, who observed the formation in a solution of sulphur in a hydrocarbon, first of prismatic crystals, afterwards, when the temperature was sufficiently low, of octahedra. By this experiment of M. Schützenberger's, it is proved that melted sulphur crystallises below 100° in octahedra of the fourth system without the aid of any solvent. The facts will probably be turned to account in the study of the formation of natural crystals.

MM. Troost and Hautefeuille contributed a memoir at a recent meeting of the Academy, on the production of paracyanogen and its transformation into cyanogen; in undertaking the investigation they considered it interesting to examine whether the relations of cyanogen and its isomer were analogous to those of white phosphorus and amorphous phosphorus. In the present memoir they consider the transformation of cyanogen, free or in combination, into paracyanogen. An examination of the action of heat upon cyanide of mercury has shown that the proportion of paracyanogen formed is influenced equally by the temperature at which the decomposition of the cyanide is effected, and by the pressure exerted by the cyanogen upon the decomposing salt. A number of experiments were made in sealed tubes placed in various heated fluids; one indispensable precaution to be attended to in making these experiments, MM. Troost and Hautefeuille have found to be the equal heating of the tube at all points, otherwise a portion of the cyanide of mercury escapes decomposition, apparently volatilising, and condenses upon the cool portions in colourless crystals belonging to the system of the right prism with square base. This experiment confirms the observations of M. Des Cloizeaux. A table giving the results of experiments shows the advantage, in regard to the yield of paracyanogen, of the decomposition being made at a low temperature and under strong pressure.

According to Thaulow, cyanide of silver, under the influence of heat, yields half its cyanogen in the gaseous state, incandescence takes place at the same time, and the other half of the cyanogen becoming paracyanogen remains united to the silver in the form of a paracyanide. M.M. Troost and Hautefeuille find that cyanide of silver does not decompose at 350° (boiling mercury), but that the decomposition ensues at a temperature very little higher. Heated gradually to 440° and maintained at this temperature it is decomposed completely without fusion or ignition taking place. The proportion of cyanogen which, under these conditions, passes into the state of paracyanogen is about 17 per cent if made in vacuo; it attains 20 per cent under atmospheric pressure; and in sealed tubes, where the pressure is about 60 atmospheres, it may amount to 64 per cent. Cyanide of silver, slowly heated up to about 600°, under ordinary atmospheric pressure, decomposes without either fusion or ignition, while if the temperature be rapidly elevated, both fusion and ignition take place; in the two cases, more than half the cyanogen is disengaged in the gaseous state; the yield of paracyanogen never exceeds 41 per cent. Operating at the same temperature in closed vessels, 76 per cent is obtained. The experiments of M.M. Troost and Hautefeuille exclude altogether the idea of the paracyanogen remaining combined with the silver as paracyanide; the paracyanogen is simply disseminated in the silver, and may be separated by mercury. Paracyanogen is most easily prepared from cyanide of mercury: quantities of 5 grammes are placed in strong glass tubes of about 10 centimetres capacity; the tubes being sealed, they are heated to 440° (boiling sulphur). To separate the paracyanogen from mercury, which is intermixed, the tube opened at both ends is heated again to 440° in a current of cyanogen gas. This mode of purification is preferable to the heating to dull redness with sulphuric acid.

A note on the manufacture of phosphate of soda and fluoride of sodium has been published by M. Jean. The process usually adopted in the fabrication of neutral phosphate of soda consists in attacking the tribasic phosphate of lime, either in the form of nodules or calcined bones, with sulphuric acid; thus a solution of acid phosphate of lime containing some sulphate and excess of sulphuric acid is obtained. This solution of acid phosphate of lime is treated with carbonate of soda, when phosphate of soda and carbonate of lime result, but a large quantity of sulphate of soda, or otherwise of sulphate of lime, and free sulphuric acid requires separating: repeated and carefully conducted crystallisations are therefore necessary. M. Jean made experiments with a view of founding a better process.

The following are notes of experiments:—(1.) In fusing a mixture of one equivalent of tribasic phosphate of lime, two equivalents of sulphate of soda and carbon in excess, and extracting with cold water, a strongly sulphurous liquor containing phosphate of soda was obtained. The residue, chiefly oxysulphide of calcium contained about two-thirds of the phosphate of calcium unattacked. (2.) A second experiment made with three equivalents of sulphate gave soluble acid phosphate 14 per cent, acid in an insoluble form 13·71 per cent: with three equivalents, then, about half the phosphate is obtained in the form of neutral phosphate of soda. (3.) By increasing the amount of sulphate to six equivalents, 20·6 per cent was the yield of soluble phosphate, while the residue contained 1·933 per cent of acid combined with lime. M. Jean attributes this small quantity of phosphoric acid to the action of caustic lime, always present to a slight extent in the residue, upon the phosphate of soda after lixiviation. The decomposition of the tribasic phosphate of lime into neutral phosphate of soda may then be considered complete. Unfortunately the phosphate obtained in this process is mixed with a large proportion of sulphide of sodium, rendering the separation by crystallisation very difficult, and consequently destroying the industrial value of the process. The reaction has given better results in the preparation of fluoride of sodium. A mixture of 40 parts of fluoride of calcium, 80 of sulphate of soda and carbon in excess, was fused in a metal crucible. The mass exhausted with water gave a solution containing sulphide and fluoride of sodium; only a trace of hydrofluoric acid was detected in the residue, composed as before of oxysulphide of calcium. Another fusion was made, in which carbonate of lime was added to endeavour if possible to remove the soluble sulphur compounds. The mixture was made of 100 parts of fluoride of calcium, 140 of carbonate of lime, 200 of sulphate of soda and carbon. In treating the mass with water, a limpid solution of fluoride of sodium was obtained quite free from sulphide. Traces of hydrofluoric acid were detected in the residue. By concentration and crystallisation, fluoride of sodium in great purity is obtained. Should the application of this salt at any time become important, this process will enable fluoride of sodium to be manufactured in large quantity and at a low price.

The "*Messager de Toulouse*" records an interesting phenomen which occurred at Toulouse a few evening ago, called by the people a rain of sulphur. The earth was covered with a yellow powder bearing great resemblance to pulverised sulphur. The powder was composed of the pollen of flowers borne by a strong wind from the pine forests.

The meeting of the Academy held on the 27th of April requires little space. The only two memoirs of chemical interest were, the preparation of magnesia as a refractory substance, by M. Caron, already translated in full, and the association of the incandescence of magnesia to that of the carbons in the voltaic arc, by M. Le Roux. By placing the base of a cylinder of magnesia about eight millimetres in diameter at a little distance from the carbon points, so that the arc may just touch it, the magnesia acquires a degree of incandescence comparable to that part in the bordering carbon craters. At the same time the light acquires a remarkable degree of constancy.

CORRESPONDENCE.

SCIENCE TEACHING IN SCHOOLS.

To the Editor of the Chemical News.

Sir,—I am glad to see that the important question, "How to teach Science in Schools?" is being discussed in your Journal, since your readers are qualified, not only to understand the arguments advanced, but also to give reasons of their own in justification of their views.

Perhaps it may be allowed to one who has taught science in schools during five-and-thirty years, and is now about to retire, to give his views, so far as they can be expressed within the short space you can afford him.

The teacher should, I think, start from the fact that boys are good observers, and bad theorists. They are fond of observing the habits of animals, and delight in anecdotes respecting them; they take every opportunity of witnessing and performing experiments, not forgetting those of the fifth of November; their tops, marbles, kites, and squirts, to say nothing of cricket and racket, are all experimental, and gratify their love of active observation. I don't know how it is, but as boys grow up into men, they become worse observers, and not always better reasoners. But taking it for granted that boys love experiments, and hate the explanation, we have, I think a clue to the nature of the boy's mind and the mode of operating upon it in the way of scientific teaching.

The lecturer ought, according to my view, to adhere strictly to the Baconian, or if you like, to the Comtean method of dealing only with phenomena and their laws. Let him say nothing of theory: let him avoid the causes of things, and not seek for the origin of light and electricity: let him avoid all those subtle notions connected with heat, and the convertibility of force: let him eschew molecular motions and molecular changes, and never give as a law what is only an hypothesis.

I know it is difficult to do this, because our knowledge advances by trying what we suppose to be true, by what we know to be true. This is fair work for societies, transactions and journals; but it should be carefully kept out of schools. There is a vast, but pleasant field for the earnest teacher to travel over with his pupils, if he strictly confine himself and them to the laws of phenomena.

Science is constantly engaged in solving three great problems—1st, given the phenomena to find the law; 2nd, given the law, and some of the phenomena, to find those quantities which are to serve as *data* for the prediction of other phenomena; 3rd, given the law and these data to foretell the phenomena. Now it is the first only of these problems that can ever be completely solved, and it is this only that we should introduce into schools. If this be well done, it will lead a few out of many boys to seek out at a later period the means for following up the other two. They may even do so to some extent while at school, if the mathematical master happen to sympathise with experimental science.

The lecture should be experimental; only the simplest numerical data being used. The leading points should be exhibited in clear writing on a large sheet of paper. The lecturer should guide his class in the difficult art of taking notes, and every boy should send up a written account of each lecture. This will not only tend to fix the teaching, but will give the boy a wholesome exercise in writing English about what he knows, instead of the ordinary subject of themes, such as "love of country," &c., of which he is ignorant.

If the written accounts are two numerous, the masters of the school may assist the lecturer in reading and correcting them. The lecturer should be deliberate and distinct in his utterance, and avoid eloquence with as much horror as a sensible man avoids fine writing. Moreover he should encourage his pupils to ask questions, and to request the repetition of such or such an experiment.

Much more might be said, but as I do not intend to trouble you with a long letter, I conclude.—I am, &c.,

C. Tomlinson.

King's College, May 16th, 1868.

MISCELLANEOUS.

Electric Light.—Some recent correspondence between the Trinity-house and the Board of Trade shows that the electric light at Dungeness can now be worked by either of the two engines, so that no disturbance occurs when one requires repair. the services of the high-class engineers and firemen have been dispensed with, and the Elder Brethren have since been enabled to do that which the connexion of the men with the trades union prevented —viz., to have their own ordinary keepers trained to drive the engines, as well as to attend to the lamps, a steady old experienced keeper being placed at the head of the establishment. The magneto-electric apparatus shown at the Paris Exhibition presented several improvements. The working by either of two machines showed that the power or the light can be duplicated in thick weather; and the engines were utilized for working the pumps of an air fog-trumpet. The electric light was compared with the flash of a first-order revolving oil apparatus belonging to the French authorities; and at 15 miles' distance the Trinity-house engineer, Mr. Douglass, estimated the power of the fixed electric light at twice that of the flask of the oil light. The superiority of penetrating power of the electric light in fog was shaken by some experiments made by the Royal Engineers, but it turned out that this result, so different from all other experience, arose from a settlement in the wood-work supporting the electric lens, causing the lens to be out of its proper position. Since the alterations made at Dungeness the light there has worked with great regulaaity and efficency; and the Elder Brethren have proposed to place similar lights at the South Foreland, Lowestoft, and Souter Point. The Board of Trade approve the extension of this mode of illumination to the South Foreland and Lowestoft, but at present suspend their decision respecting Souter Point. The Committee of Elder Brethren who attended at the Paris Exhibition say:—"As far as the eye is an test, the power of the English fixed light was considerably in excess of the French, and when both machines were in use and there was a good current the fixed beam of the English light did not contrast unfavonrably with the revolving one of the French, the flash of which is of great power. The contrast of the electric fixed light with the French first-order oil dioptric revolving light was very marked: indeed, the one may be said to put the other out. But the most beautiful feature of the electric was the extraordinary beam it gave. It shone night after night, large, steady, and lustrous as a planet, and you could see in the darkness a beam passing as far as the eye could see. From the tower, with the light at our back, it was very marked, and quite lit the hills round Paris. The whole horizon in the plane of the light showed the white beam, and at the distance of four miles it shone upon the windows of some houses, making them appear to be lit up. By extinguishing and relighting quickly several times this was very plain. Altogether the light was very remarkable, and the committee are glad to be able to report such an advance as the powers of the light show over that at Dungeness; indeed, the latter gives to the observer no conception of what the present one is, and it is satisfactory to know that the result of five years' work and observation, with imperfect and ill arranged apparatus, has now borne such good fruit, and that as England was the first to test and adopt this adjunct to the sources of lighthouse illumination, so she still retains her superiority. It is due, however, to Mr. Holmes to say that great as are the improvements already effected, he states thst he is confident he can yet greatly increase the illuminating power before the present apparatus is re-erected at a permanent station."

A Telegraph Feat.—At an early hour this morning (Feb. 1) the wires of the Western Union Telegraph Company from San Francisco to Plaister Cove, Cape Breton, and the wires of the New York Newfoundland, and London Telegraph Company from Plaister Cove to Heart's Content, were connected, and a brisk conversation commenced between these two continental extremes. Compliments were then passed between San Francisco and Valentia, Ireland, when the latter announced that a message was just then being received from London direct. This was said at 7.20 a.m., Valentia time, Feb. 1. At 7.21 a.m., Valentia time the London message was started from Valentia for San Fransciso; passed through New York at 2.35 a.m., New York time; was received in San Francisco at 11.21 p.m., San Francisco time, Jan. 31, and was at once acknowledged—the whole process occupying two minutes actual time, and the distance traversed being about 14,000 miles! Immediately after the transmission of the message referred to, the operator at San Francisco sent an eighty-word message to Heart's Content in three minutes, which the operator at Heart's Content repeated back in two minutes and fifty seconds. Distance about 5,000 miles.—*N. Y. Journal of the Telegraph.*

Aluminium Bronze.—M. Evrard, in order to manufacture aluminium bronze, does not combine copper and aluminium directly together. He makes use of a kind of pig iron containing aluminium. This is slowly heated to fusion, when copper is added to the melted mass. Aluminium, having more affinity for copper than for iron, abandons the latter and combines with the copper. After the entire mass has been well stirred it is allowed to cool slowly, so as to permit the aluminium bronze, which is denser than iron, to find its way to the bottom of the crucible. The same process may be employed, according to the author, to obtain a bronze of silicium. Indeed, the affinity of copper for silicium is energetic enough to induce M. Evrard to try this method for separating silicium from pig iron by adding a proper quantity of copper.—*American Artizan.*

"Essay" on Coal, delivered in 1858, by an Oxford candidate to the examiners at Cheltenham:—"Coal is a black mineral. The way they produce it is this: First they dig a large pit in the earth. Then they cut down a quantity of timber and put it in the pit, and cover the whole with peat. Then they burn the timber. After it has been burnt once it becomes charcoal, and out of the charcoal they make *oxygen* gas, with which we light our streets and houses."

Alcohol from Wood.—In the process of making paper from wood, round disks of wood are first subjected to the action of hydrochloric acid to dissolve out the spongy cellulose. This latter has, until lately, been a waste product, but is now converted into alcohol in this way. The wood is boiled for twelve hours in hydrochloric acid, diluted with ten times its volume of water. The acid liquid, which is charged with grape sugar formed from the spongy cellulose, is then withdrawn, the excess of acid saturated with lime or chalk, and a small quantity of yeast is added, the temperature being kept at about 68° Fah. Fermentation soon ensues, and when bubbles of carbonic acid gas are no longer evolved, the liquid is distilled to obtain the alcohol.

Phosphorus in Iron.—The remarkable deteriorating effects of phosphorus in iron furnish a curious and striking illustration of Lord Palmerston's definition of "dirt"—*matter in the wrong place.* The *Colliery Guardian* says: "The phosphorus in Cleveland iron, which so seriously reduces its value in the market, and renders it necessary to bring iron from other districts to mix with the iron of the district in the puddling furnaces, and to use the ores of other districts to mix with its own—would, if extracted, even in its lowest priced form—as a manurial ingredient—be worth at least £66 per ton; as one ton of phosphorus is equal to 2 tons 5 cwts. of phosphoric acid, or 4 tons 10 cwts. of the highest qualities of Patagonian, or seven tons of Peruvian guano. There is therefore a tolerably good margin for working expenses if the process by which the phosphorus is extracted is carried out on tolerably economical principles. For instance, iron which is now worth 47s. per ton, when containing one per cent of phosphorus, would, if freed from this element, be worth at least as much as hæmatite iron, or say 54s. per ton."

CONTEMPORARY SCIENTIFIC PRESS.

Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Bulletin de la Société Chemique de Paris.

December, 1867.

Bourgougnon, "An Improvement in Saponifying Fats." Martin "On the Preparation of Alizarine from the other Colouring Matters extracted from Garancine." J. Persoz, "A new Aniline Black Dye."

Dingler's *Polytechnisches Journal.*

January, 1868.

F. Varrentrapp, "On the Electro-deposition of Iron in a Solid Form." Fortmann, "On the Theory of the Process of Roasting Iron Pyrites." R. Brimmeyr, "On Dinitronaphthol, a new Colouring Matter extracted from Naphthalene." P. Alfraise, "On J. A. Schlumberger's Method of obtaining a Green Dye from Toluidine." J. von Liebig, "On the Nutritive Properties of Undressed Flour and Unfermented Bread." "On the Use of Chemical Products in the Manufacture of Bread."

Bulletin de la Société d'Encouragement.

December, 1867.

E. Peligot, "On Sacc's Notes on the Colouring Matters in use at Neuchâtel for Dyeing Fabrics, and on the Use of Silicate of Soda for Dyeing." Dumas, "On the Use of Tartaric Acid for Dyeing." E. Peligot, "On the Use of Garancine for Dyeing." Thilloy, "On a new Bitter Principle extracted from the Bark of the Hazel, to be used as a Substitute for Quinine."

NOTES AND QUERIES.

Bleaching Woollen Rags.—These are most effectually bleached by the application of sulphurous acid. Of course, in many instances, the colour of the rags, supposing the same to belong to the class of dyed, or printed goods, will be also destroyed. Chlorine cannot be used for this purpose, for two reasons—first, because it causes woollen and silk fabrics to become yellow; and, secondly, it impairs the strength of the fibre, by entering into chemical combination with the wool, silk, and other similar substances of animal origin; as, for instance, sponge, animal gut, isinglass, &c., all of which, if requiring bleaching, are bleached by sulphurous acid.—Dr. A. A.

Lepidolite.—Your correspondent can utilise his lepidolite by extracting lithium, rubidium, cæsium, and thallium from it. The following process will answer well on a large scale:—Fuse the mineral at a red heat, pour it into cold water, pulverise and wash it, treat the washed mass to twice its weight of hydrochloric acid. After several hours' boiling, separate the greater part of the silica, add nitric acid and protoxide of iron, and precipitate by carbonate of soda, the solution being made so weak that the carbonate of lithia will not be thrown down. After evaporation in this way in an iron vessel, to separate more carbonate of magnesia, saturate with hydrochloric acid and add the proper quantity of chloro-platinate of potassium to precipitate all the rubidium, cæsium, and thallium. The filtered liquid, containing an excess of platinum and lithia, is treated with sulphuretted hydrogen to separate the platinum, then concentrated and treated with the carbonate of soda to precipitate the carbonate of lithia. By this method 1000 parts of lepidolite will give 78 parts of carbonate of lithia, 6·5 parts of chloride of rubidium and cæsium, and 0·6 parts of thallium, supposing the operation to be continuous. The advantage of this process consists in the direct fusion of the mineral, and may be applied to all lithian micas.—A Manufacturer.

MEETINGS FOR THE WEEK.

Monday.—Royal Geographical, 8½.
Tuesday.—Royal Institution, 3. Dr. M. Foster, "On the Development of Animals."
Wednesday.—Society of Arts, 8.
Thursday.—Royal Institution, 3. Prof. Grant, "On Astronomy."
— Royal, 8½.
— Zoological, 8½.
— Royal Society Club, 6.
— Philosophical Club, 6.
Friday.—Royal Institution, 8. W. E. H. Lecky, Esq., "On the Influence of Imagination upon History.
Saturday.—Royal Institution, 3. Prof. Grant, "On Astronomy."

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THE CHEMICAL NEWS.

Vol. XVII. No. 443.

ON THE PROPOSED WATER SUPPLY FOR THE METROPOLIS.*

By EDWARD FRANKLAND, Ph.D., F.R.S.
Professor of Chemistry, Royal Institution.

Out of every thousand people existing upon this planet at the present moment, three live in London. Any matter, therefore, which intimately concerns the health and comfort of this vast mass of humanity, cannot but merit earnest attention; and, moreover, if that matter be connected with scientific research, I feel sure that the members of this Institution will require no apology even for its being brought under their notice a second time.

A year ago, I discoursed to you about the chemical considerations respecting the present Metropolitan Water Supply, and I mentioned the five schemes then proposed to remedy its obvious and serious defects—excessive contamination with sewage, and great hardness—the first rendering it unfit for drinking, and the second disqualifying it to a certain extent for washing and cleansing purposes. Those schemes to which I alluded on the last occasion were the following: *First*, the sources of the Severn, proposed by Mr. Bateman; *second*, the Cumberland lakes, proposed by Messrs. Hemans and Hassard; *third*, the Thames water filtered through the Bagshot sands, suggested by Mr. Telford Macneill; *fourth*, extensive reservoirs constructed near the sources of the Thames, the scheme of Mr. Baily Denton; and *fifth*, the waters flowing down the slopes of the Derbyshire and Staffordshire hills, proposed to be brought to the Metropolis by Mr. Remington.

At that time the quality of the waters obtainable by any of these schemes had been but little investigated, and that remark still applies to the last three schemes. But in the interval, the water yielded by the two first-named districts has been, at the instance of the Royal Commission on Water Supply, submitted to a searching chemical investigation by Dr. Odling and myself, and I am therefore enabled on the present occasion to speak with confidence as to the quality of the water from both these districts.

There are also one or two points of general scientific interest which have been brought to light during this inquiry, and which I also propose to touch upon:—These are, first, the curious effect of detritus from mines upon the quality of the water with which it is mixed; and secondly, the conditions which determine the action or non-action of water upon lead.

During the past year the processes of water analysis have undergone a complete revolution. It is one of my duties to report monthly to the Registrar-General upon the quality of the Metropolitan waters, and in carrying out this work I found the methods of water analysis hitherto employed so untrustworthy as to render an almost entire remodelling of them absolutely necessary.

I propose, therefore, first to glance shortly at some of the innovations which have been made in this branch of chemical analysis. When water is to be submitted to chemical examination, it is of the utmost importance to have a sufficient and well-collected sample. On this occasion the completeness of the investigation, as regards the two proposed schemes, has been very materially assisted by the judicious choice of samples supplied by Dr. Pole, F.R.S., who went down to the districts and collected the samples which were afterwards submitted to chemical analysis by my colleague and myself.

The first thing to be determined in a water analysis is the "total solid impurity," as it is termed, *i.e.* the total amount of solid matter with which the water has been contaminated since it was submitted to the natural process of distillation. This quantity of solid impurity is determined by taking a known volume of the water and evaporating it down to dryness in a previously weighed platinum vessel. The solid impurity contains both organic matter and inorganic or mineral matter. The most important of these two classes of substances contained in the solid residue is undoubtedly the organic matter. Now, even at the present moment, the actual weight of this organic matter cannot be determined by chemical analysis; in fact there is no process known to science by which its weight can be even approximately estimated; but it is possible to determine, in a given hulk of water, the quantity of the two principal constituents of this organic matter, *viz.* the carbon and nitrogen which enter into its composition. For this purpose a separate quantity of the water is evaporated down to dryness; but in this case the process is conducted in a glass vessel, and before evaporation the water is mixed with sulphurous acid in order to expel the carbonic acid, which is partly dissolved in the water and partly combined with lime and magnesia. Other precautions also have to be taken, but I hesitate to enter into the details, which I fear would only weary you. However, I think that it is desirable just to show you the general plans on which the determination of the organic carbon and nitrogen, in the residue thus obtained by evaporation in the glass dish, is effected. The operation is performed in the following manner:—The contents of the glass vessel are very carefully scraped out and rubbed off the sides of the vessel by a substance known as chromate of lead, a finely powdered somewhat gritty material, which very completely effects this object, and enables us to transfer the water residue gradually into a piece of hard Bohemian glass tube closed at one end. This tube is then filled up to within about four inches of the mouth with coarsely granulated oxide of copper, and upon that is placed a small quantity of bright metallic copper to decompose oxidised compounds of nitrogen. The tube is then laid in a gas furnace, called "the combustion furnace." Before combustion commences the entire tube is made perfectly vacuous, all the air is pumped out of it, so as to get rid of the atmospheric nitrogen which would vitiate our result. This is done by means of a mercurial pump invented by Dr. Sprengel, by means of which we can extract almost the last trace of atmospheric air contained in the tube. The latter is then gradually heated to redness, during which process the carbon and nitrogen of the organic matter in the water residue are converted, the first into carbonic acid gas, and the second into nitrogen and nitric oxide gases. From the volume of each of these gases the weights of carbon and nitrogen can be calculated with great precision. (Experiment performed.)

Now the nitrogen in the result of the analysis is also derived from any ammonia present in the water, and it is therefore necessary to determine how much is due to that source. This estimation of ammonia is perhaps the only *rapid* and *easy* process connected with water analysis which may at the same time be regarded as satisfactory. For these simple processes of analysis when they come to be rigorously tested generally prove to be very incorrect; but this has survived the test of experience, and is capable of determining the result with great precision and readiness. I have here five glass cylinders. The water in the first contains no ammonia at all; the second contains a certain small quantity; the third twice as much as the second; the fourth three times as much, and the fifth four times as much as the second. To each of these vessels I shall now add an equal volume of a test solution, which strikes a peculiar yellow or orange-yellow colour with the ammonia in the vessels. This is known as the

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* Read before the Royal Institution of Great Britain, Friday, April 3, 1868.

Nessler test, having been invented by a German chemist of that name. (The experiment was performed, the water in the four last vessels assuming different shades of orange colour, in proportion to the quantity of ammonia contained in them; the water in the first vessel remaining colourless.)

Now we have still one other process at which it is necessary to glance for a moment, viz.—the process for determining the nitrogen existing as nitrates and nitrites. It is called combined nitrogen, but it is not organic nitrogen, although it has in most cases been derived from organic matter. The water residue used for the determination of the amount of solid impurity is dissolved in a small quantity of water; sulphate of silver is then added, by which the chlorides are converted into sulphates. The resulting liquid, after filtration, is transferred to the upper part of a glass tube filled with mercury. It requires to be mixed with rather more than its own weight of sulphuric acid, which is introduced in the same way. It is then only necessary to shake up this mixture, the mouth of the tube being closed with the thumb. Very soon the mercury begins to act on the nitric acid, converting it into a colourless permanent gas called nitric oxide, which only requires to be measured in order to determine the amount of nitrogen originally present in the water in the shape of nitrites and nitrates.

There is only one other determination I will trouble you with, and this I do principally for the purpose of introducing to your notice a very ingenious piece of apparatus, an application of the Sprengel pump, which has just been contrived by my assistant, Mr. McLeod. It is designed to extract the gases which are dissolved in waters. By this instrument we can not only measure the whole of the gases present in the water, but we can determine how much of the gases can be expelled at the ordinary temperature, and how much more will come off when you boil the water *in vacuo*. This gas is then submitted to the usual eudiometrical investigation, to ascertain the quantity of carbonic acid, nitrogen, and oxygen—the three gases which almost invariably occur in the waters submitted to analysis. (Apparatus shown at work.)

Now it is not necessary for me on the present occasion to go at all into the details as regards the sources of the two proposed water supplies for London. This I did on the former occasion pretty fully. I will only refer you for a moment to the large map before you, which shows the districts from which the supplies would be taken and the course of the conduits to the metropolis. By the Welsh scheme, the water would be collected on the slopes of Cader Idris and Plynlimmon, from whence it would be brought by a conduit to within 10 miles of London, where it would be stored in reservoirs 400 feet above high-water mark. The other scheme proposes to bring the water from the lakes of Cumberland, past several large towns, laying under contribution the Bala Lake, in Wales, if necessary, and the combined waters would then be brought to the metropolis after distributing a certain amount to the large towns on their route.

It is, perhaps, necessary just to say a word or two in order to disabuse your minds of the idea that these schemes are intended to inflict any injury upon the present water companies. Ample provision is made in these schemes for the complete compensation of the existing companies, and the only conceivable mischief in this respect which can be done by the adoption of one scheme or the other, would be the abolition of certain Boards of Directors which now exist, for the administration of the affairs of the eight or nine companies which supply London.

These schemes are of course very costly. It quite staggers one at first to think of the amount it is proposed to expend upon them. Thus, Mr. Bateman's scheme, which is to bring water from the mountains of North Wales, is calculated to cost, for a supply of 220,000,000 gallons per day, the sum of £10,850,000; whilst the scheme for bringing water from the lakes of Cumberland is put down, for 250,000,000 gallons a day, at £13,500,000. Now these are startling figures; but I imagine that all we have to look at is the simple question, How much shall we have to pay for the water when these schemes are carried out? If you go into that matter you will find, according to the calculations of the engineers—I will not say they are always to be implicitly relied upon, perhaps a certain percentage must be allowed—but taking their calculations as correct, it actually follows that after compensating the existing companies, and after expending this enormous amount upon the works, we shall be supplied with this very pure water at a less cost than that which we pay at the present moment. We pay at present about 1s. 5d. in the pound of rent for water. By Mr. Bateman's scheme we should be charged a domestic rate of 10d. in the pound, or two-thirds of what we now pay, *plus* a public rate of 2d. Messrs. Hansard and Heman's scheme would be met by a domestic rate of 1s. 1d. in the pound. Now I think, if we are actually to be gainers by this transaction, the enormous sums necessary to be expended on these works need not frighten us, and need not prevent us from taking them into our serious consideration.

Let us just pause for a moment to consider the purely mechanical relations of the proposed to the present Metropolitan supply, because this will somewhat help you to comprehend how it is that, having expended all this money upon the works, we shall still have water cheaper. In the first place, every gallon of water which is now delivered in London has to be pumped up from nearly the sea level, to an average height of about 250 feet, Then, again, the present supply is intermittent; the proposed will be constant. With regard to the pumping part of the process, that in the proposed scheme would be replaced by the work of gravitation. The gigantic and magnificent engines employed at the present moment in London for raising this vast volume of water—100,000,000 gallons daily—are painful for the philosopher to contemplate. You have here a stupendous waste of power employed in doing over again an amount of work which was previously executed for us gratuitously. The sun, in his prodigality of power, flings up far above the cross of St. Paul's this daily supply of 100,000,000 gallons, and we, in our imbecility, allow it to soil itself by flowing down again nearly to the level of the sea, and then we erect immense pumping engines and expend 200 tons of coal daily to raise this water a fraction of the height from which we had previously allowed it to fall. All this will be saved by the proposed schemes.

We talk of the exhaustion of our coal fields and of the necessity of conserving our supply as much as possible, and although the amount thus saved would make but a poor figure in Mr. Jevons's 100,000,000 tons a year, yet this is a kind of work which can be done better by solar heat than by the action of coal; and it is not very often that we are thus able to substitute, with advantage, natural for artificial force.

Now with regard to the quality of these waters which it is proposed to bring to London, you have in the following tables a comparative statement, showing the results obtained by the analysis of the proposed Welsh and Cumberland waters, and of the present Metropolitan water supply:—

TABLE A.—*Results of Analysis of Welsh, Cumberland, and London Waters.*

100,000 PARTS OF WATER GAVE—

	WELSH. Mean.	CUMBERLAND. Mean.	LONDON. Mean.
Total solid impurity ..	4·85	4·74	32·66
Organic Carbon	.460	·276	·270
Organic Nitrogen	·006	·010	·025
Ammonia	·903	·002	·003
Nitrogen as Nitrates and Nitrites	·017	·009	·323
Total combined Nitrogen	·025	·021	·354
Previous sewage or manure contamination	47	6	2930

	Welsh. Mean.	Cumberland. Mean.	London. Mean.
Hardness..	1·4	2·2	20·13
Lime	·599	1·113	9·822
Magnesia	·288	·272	·890
Potash	·126	·158	·851
Soda	·679	·532	1·666
Sulphuric Acid	1·093	·969	3·674
Carbonic Acid	·201	·691	7·187
Silica	·254	·133	·834
Chlorine	·876	·490	1·480

Table B.—*Analysis of London Waters*, 1867-68.

100,000 Parts of Water contained—

	Total Solid impurity. Mean.	Organic Carbon Mean.	Organic Nitrogen. Mean.	Previous Sewage Contamination. Mean.	Hardness. Mean.
Thames.					
1867	28·5	·272	·013	2062	19·3
Jan., 1868 ..	30·9	·399	·048	3150	17·3
Feb. ,, ..	31·4	.339	.043	3010	19·3
Mar. ,, ..	30·0	·216	.028	2388	19·3
River Lea.					
1867	27.5	·196	·005	1611	19·3
Jan., 1868 ..	33·1	·131	·019	3030	21·6
Feb. ,, ..	32·6	·244	·031	3320	20·5
Mar. ,, ..	28·7	·088	·016	2115	19·5
Kent Co.					
1867	39·3	2·13	·002	3619	25·6
Jan., 1868 ..	44·8	·064	·013	3770	26·2
Feb. ,, ..	59·2	·081	·013	5330	30·0
Mar. ,, ..	70·2	·093	·029	3680	32·3

The quantity of the solid impurity contained in a water is a very important matter, apart from the consideration of the quality of the substances which compose this impurity. Waters leaving a small amount of residue upon evaporation are usually well fitted for domestic use. They are invariably the best for manufacturing purposes. as they effect a great saving in heat when used for steam boilers. I was shown the other day some cakes of carbonate of lime, a quarter of an inch thick, which had been removed from a locomotive boiler at the Deptford Railway Station, in which they had been formed in forty-eight hours; through this substance heat passes with extreme slowness, so that a considerable quantity of fuel is wasted. It will be seen from the first of the above tables that, on an average of all the samples, the total solid impurities amount in the two schemes to about 1-7th of those in the present water supply; but if we might venture to take the water in the proposed large storage reservoirs as equal in this respect to the water now stored in the lakes, it would be about 1-10th of that which is found in London waters.

Now this solid residue is partly mineral and partly organic. Let us glance first at the organic portion. This organic matter present in the original water may be either living or dead. The detection of the former class of impurities belongs more to the province of the naturalist than to that of the chemist; but it may be remarked in passing, that this form of organic impurity must necessarily be in suspension and not in solution. We cannot conceive of organised beings existing in solution—it is impossible. But it does not from this follow that these suspended matters can be removed from water by filtration.

It is well known that the ova of many species of animalculæ cannot be removed thus, they pass through the best filters; and it has also been proved that what is believed to be the cholera poison passes through filters, and cannot be arrested. This is a most important consideration in connection with water which is contaminated with sewage and manure matters; and it is necessary that such water should, at all events, be as well filtered as possible. The present water companies supplying London cannot possibly be blamed for the original quality, of the water which they supply. They cannot hinder the 600,000 persons who live on the banks of the Thames from pouring their refuse into the river; but they can filter this impure water. They can, and indeed by Act of Parliament they are supposed to be compelled to deliver this water in a bright, transparent, and filtered condition; and they can in this way, as far as it is possible by filtration to do it, remove these suspended organic contaminations from the water.

But how does the matter stand? Here is a sample of water which I drew from the Lambeth company's main on the 4th of March. You see that the water is not filtered. It is filtered by Act of Parliament! but it is curious to observe that so much pollution can pass through an Act of Parliament. Here too is a sample of the same company's water collected on the 21st of January; and it is a fact, that during the whole of that interval and almost up to the present time, this water has been much in the same condition. Those of my audience who are supplied by the Lambeth company, or the Southwark and Vauxhall company, or by the Chelsea company, will bear me out as to the condition in which those companies have delivered water during the past two months. In fact, not only for the past two months, but during the entire year, water is often delivered in London very imperfectly filtered. The Southwark company during the whole of last year, with one exception, delivered from its mains, when the samples were drawn for analysis, turbid water, imperfectly filtered—most of the other companies were to a less extent guilty of the same thing. Of the companies which draw from the Thames, the West Middlesex and the Grand Junction are the two which filter their water best; but the only company which delivered water uniformly transparent and well filtered was the New River company.

I have stated that the absolute quantity of the organic matter in solution in water cannot be ascertained, but the amount of carbon and nitrogen contained in this organic matter can be estimated by the process of combustion which I have exhibited to you. The amount of organic carbon and nitrogen in the several waters I have referred to, is represented in the second and third lines of table A, and in the second and third columns of table B you will see that, with regard to these elements of the organic matter in solution, there is not a very striking difference between the three different classes of waters. There is an excess of organic nitrogen in the case of the London waters, and of organic carbon in the case of the Welsh waters.

The organic matter, of which the elements are thus determined, may be either animal or vegetable, and the nature of it has much to do with the probability of its being noxious or innocuous. The animal or vegetable source of the organic matter may be judged of by the proportion of nitrogen to carbon, as determined by analysis: that from animal sources contains a larger proportion than that derived from vegetable sources; and in this way it is easy to see that the organic matter in the Welsh and Cumberland waters is of a different character from that contained in the London waters. The London river-waters, especially when turbid, contain a much larger proportion of nitrogen to carbon than is contained in other waters, thus proclaiming the animal origin of some portions of the organic matter.

When I addressed you on this subject last year I stated that by operating upon one litre of water, one per cent of unchanged sewage could be detected with certainty, but that smaller percentages ought, in operations upon such a small quantity of water, to be considered as falling within the possible errors of experiment. In like manner, by operating upon 10 litres of water 1-10th of a per cent of unchanged sewage could be detected. During the past year, however, this process of analysis has been so improved that an amount of organic nitrogen corresponding to at most 3-100ths of a per cent of unchanged sewage can now be detected with certainty in *one* litre of water. Now about 4-5ths of the organic nitrogen contained in *perfectly fresh sewage* exists there as urea, which undergoes such rapid decomposition into the mineral compound carbonate of ammonia, that little or none of it ever reaches the Thames from the towns whose sewers debouch into this river. As average London sewage contains 10 parts of combined nitrogen in 100,000 parts, it follows that 100,000 parts of this sewage as it flows into the Thames will contain only 2 parts of organic nitrogen. Further, if the sewage of the 600,000 persons who drain into the Thames above the point whence the water companies draw their supply have the strength of average London sewage, it will amount to 18,000,000 gallons daily, and if the average flow of the river at Teddington be taken at 800,000,000 gallons daily, it follows that the river will there contain 2250 parts of sewage in 100,000 parts, or 2¼ per cent. This quantity of sewage, if in the condition as delivered at the sewer outfall, would contaminate the whole volume of the river, only to the extent of ·045 part of organic nitrogen in 100,000 parts of water. Now on the 21st of January last the water delivered by the five companies drawing their supplies from the Thames contained the following amounts of organic nitrogen in 100,000 parts :—

Chelsea (turbid) ..	·058	Grand Junction (clear)	·031
West Middlesex (clear)	·027	Lambeth (turbid) ..	·062
Southwark (turbid) ..	·061		

It will be seen, therefore, that three out of the five samples of water actually contained more organic nitrogen than would be due to the admixture of the 18,000,000 gallons of sewage which are poured into the Thames above the point from which these samples came. But Thames water holds in solution a certain amount of peaty matter which contains organic nitrogen; a sufficient proportion of this substance, however, to furnish the above larger quantities of organic nitrogen would render the water brownish yellow when viewed in a quart decanter, whilst these samples of Thames water were, when filtered, colourless or nearly so. I am therefore of opinion that the Thames water delivered in London by the Chelsea, Southwark, and Lambeth companies on the 21st of January last contained unoxidised sewage. This opinion is confirmed by the results of some experiments which I have recently made in my laboratory, and which show that, contrary to the generally received opinion (which is, however, based upon no reliable experimental data), sewage in which the urea is already decomposed undergoes further change with extreme slowness, even when freely exposed to the air and mixed with large volumes of water. Thus I find that a mixture of weak sewage from one of the London sewers with nine times its volume of water (containing bicarbonate of lime in solution) at a temperature of 20° to 25° C., and well agitated every day by being made to flow in a thin stream through 3 feet of air, oxidises but to a slight extent in the course of eight days. Immediately after mixture this sewage-contaminated water contained ·267 part of organic carbon and ·081 part of organic nitrogen in 100,000 parts, whilst after 96 hours it still contained ·250 part of organic carbon and ·058 part of organic nitrogen, and even after the lapse of 192 hours the undecomposed organic matter still contained ·200 part of organic carbon and ·054 part of organic nitrogen.

In connection with the organic matter in water, the investigation of the Welsh and Cumberland samples revealed a very curious effect produced by the admission of the detritus from lead and other mines into the waters of the streams and lakes. It was found, upon analysis, that water thus mixed with the milky streams from the crushing engines of mines, contained a wonderfully small quantity of nitrogenous organic matter. You will see this brought out in the following table :—

Effect of Detritus of Lead Mines upon the Organic Matter in Water.

	Organic Carbon in 100,000 parts of Water.		Organic Nitrogen in 100,000 parts of Water.
CUMBERLAND WATERS.			
Glenridding Beck	·116	.. ..	·000
Stream flowing into Thirlmere	·066	.. ..	·001
Goldrill Beck	·262	.. ..	·001
WELSH WATERS.			
Ceryst	·209	.. ..	·000
Upper Clywedog	·544	.. ..	·000
Lower Clywedog	·242	.. ..	·001
Tarannon and Ceryst	·304	.. ..	·001

This table shows that whilst some of these waters exhibit a rather large quantity of organic carbon, they contain very little or no organic nitrogen. And further, these waters, though they hold in solution a considerable amount of peaty matter, are perfectly colourless when seen in a quart decanter; but when viewed through a stratum 15 feet thick they exhibit the magnificent blue-green tint of absolutely pure water, a tint which is brought out when water is passed through animal charcoal. We may illustrate the action of this crushed quartz of lead mines and of animal charcoal, by three samples of the water delivered to this Institution by the Grand Junction Company, and which are contained in the tubes before you, each of which is 15 feet long. The centre tube contains the water just as it passes into the cistern, the water in the second tube has been shaken with powdered flint, whilst the water in the third tube has been passed through animal charcoal. If we now send through each tube a parallel ray of electric light, which ray will have to pass through a stratum of about 15 feet of water, you will perceive that the first gives a yellow-brown tint upon the screen; the second, a beautiful green tint, and the third, a turquoise colour: the last two powerfully reminding the observer of the lakes of Lauerz and Zug, as seen from the summit of the Rigi. (Experiment performed.) In fact this is doubtless the chief cause of that magnificent colour which we witness in many of the Swiss lakes, and which we see for instance in the Rhone when it leaves the lake of Geneva, and the Limmat as it flows from the lake of Zürich. The streams running into the heads of these lakes come in turbid and filled with finely crushed quartz and other minerals, the detritus from the glaciers which are the source of those streams. In the lakes, these fine peaty particles of mud subside and attract to themselves the colouring matter which is to be found in almost all waters.

We see in two of the English lakes some indications of this blue-green tint appearing, and it is precisely in the localities where the streams from the lead mines come down into the lakes. You see near the mouths of those milky streams which come down into Ullswater from Glenridding, and from the "Old Man," into Coniston Lake, the indications of this precipitation and removal of those brown substances which discolour the natural waters of our lakes. We have thus here, perhaps for the first time, evidence of improvement of the quality of water by the admission into it of manufacturing refuse. Hence the diversion of these waters coming from lead and other mines, which would seem at first sight to be necessary, need not be effected; on the contrary, their admission into the lakes would be of great benefit to the waters, they would to some extent decolourise them, and would tend to reduce the nitrogenous organic matter to the lowest possible amount. There appears to be no need to fear that such streams will carry anything into the lakes which will be deleterious to the drinker. All those streams have been carefully examined for lead, arsenic, copper, &c., and only in two cases has the faintest trace of lead been discovered, and the quantity was so minute that it is absolutely impossible it could be deleterious, even if the water coming from the mines themselves were to be drunk, but mixed with the large quantities of the lake water, it becomes utterly inappreciable.

The fatal effect said to be exerted upon fish by these milky streams from mines is most probably due to a mechanical action of the finely divided quartz upon their organs of respiration—an effect analogous to that (but of an exaggerated kind) from which the Sheffield grinders notoriously suffer.

(To be concludedin our next.)

ON THE
ESTIMATION OF SULPHUR IN COAL GAS.

M. **Albert Ellissen**, Engineer, chief of the Experimental Works of the Paris Gas Company, has forwarded the following communication to the Editor of the *Journal of Gas Lighting*, in reply to the article by Mr. Valentin, principal assistant in the Royal College of Chemistry. (*Vide* Chemical News, Feb. 21, 1868. Vol. xvii., p. 89.)

"The question of the estimation of sulphur in purified coal gas, which has for many years occupied the attention of engineers and of the public in England, should be considered from two points of view altogether different, which I shall call the theoretical and the practical views of the question.

"Looking at it theoretically, or from the scientific point of view, the object is to determine the mathematically exact quantity of sulphur in the gas. When viewing the question practically, it is necessary to ascertain the causes which obstruct the detection of that substance, and to determine the quantity which, during the combustion of the gas for domestic purposes, might produce an effect injurious to health, or be destructive to furniture, books, &c. Does the process mentioned by Mr. Valentin accomplish either of those objects? I think not, and I will endeavour to show why.

"His process, which consists in burning gas mixed with air when passing over spongy platinum, is not new, a similar arrangement having been used in 1864 by Dr. Letheby, in his experiments on the sulphide of carbon in gas. Even according to Mr. Valentin, that method does not determine the total quantity of sulphur in the gas, and I think that is less owing to the imperfect absorption of the sulphur products, or to the difficulty of extracting them from the platinum by washing, than to the imperfect combustion of the sulphur; and I have no doubt that, if Mr. Valentin were to substitute pure oxygen for atmospheric air in his experiments, he would obtain much more favourable results, and probably obtain the whole of the sulphur contained in the gas. But it appears to me that the process adopted in my experiments, afterwards repeated by Mr. Alfred Anderson and by Mr. Valentin, which consists in passing the gas over quick lime or soda lime, heated to redness in a drawn-iron tube, is more simple than that of Mr. Valentin, as it does not require the making of oxygen for special aspiration, and gives exact mathematical results of the quantity of sulphur in the gas. I cannot admit that the use of nitric acid or of hypochlorites can occasion the least difficulty to experimental chemists.

"In reply to the doubt expressed by Mr. Valentin as to the correctness of the proportions I obtained by means of lime in 1864, I wish him to bear in mind that those experiments were made at the experimental works of the Paris Gas Company, expressly on gas obtained by varied distillations of coal of the most different kinds possible; which circumstance explains the great differences in the results obtained.

"Let us look, however, to the practical part of the question, which, in point of fact, will constitute the only interesting part of the discussion that will probably take place this year, in considering any measure on the subject to be brought before Parliament. In the reports of Dr. Letheby to the Commissioners of Sewers of the City of London, on the sulphur compounds in gas, which must be first considered, he states that, during the combustion of gas, the sulphur it contains produces sulphurous and sulphuric acid, which injure furniture, and especially books in libraries. I will not again discuss what value is to be placed on that statement, for I have previously shown how many other causes contribute to the production of sulphuric acid in the atmosphere of large towns; but there can be no doubt that, if it be admitted that any damage is really done by the sulphur in gas, it can only be the portion of it which is converted by combustion into sulphurous or sulphuric acid that can really produce any injurious effect. The other portion of the sulphur, which is not consumed, and which consequently escapes into the atmosphere in the form of sulphide of carbon or vapours of sulphuretted organic products, cannot have any corrosive action. Why, therefore, should any trouble be taken to devise complicated apparatus to make it apparent? The practical problem then remains, to provide an apparatus by which all the sulphurous products during the combustion of gas, in the ordinary methods in use, can be completely ascertained; and I think that the apparatus contrived by Dr. Letheby, which is generally employed in England, fulfils all the conditions required for that kind of experiment.

"In that apparatus the gas is consumed with a Leslie's burner, under the best practical conditions for a good oxidation of the sulphur contained in the gas. The consumption with that burner is so slow, that certainly during the ordinary burning of gas so perfect a combustion does not take place, and which may be made similar to the blue flame necessary in heating apparatus—a mode of consumption which should be taken into consideration in the use of gas for domestic purposes. The condensation of the sulphur products (sulphurous and sulphuric acids) in the glass cylinder is complete; experiments having proved that a sensibly greater amount of sulphur is not obtained by increasing the number of those vessels, not by filling them with ammonia. The apparatus of Dr. Letheby has the additional advantage that the experiments may be made on the average quality of the gas manufactured during the day of twenty-four hours, and does not require the least superintendence. An interval of a few seconds is sufficient to empty the liquor collected in the cylinder, the quantity of which affords a valuable check on the correctness of the progress of the experiment, and a fresh experiment may be immediately commenced by merely opening the stop-cock for the gas.

"In a practical point of view, Mr. Valentin's apparatus is far from offering the same advantages. In the first place, the gas is consumed or decomposed under conditions not in the least like the usual manner of burning gas in private houses, and though the apparatus does not estimate the whole of the sulphur in the gas, nevertheless in these experiments a part of it is taken cognisance of which practically is not of the least interest, as it generally escapes into the air in a form that is not injurious. Furthermore, the apparatus is complicated; it requires difficult manipulation, a complicated fitting up and taking down, a continued superintendence during the whole time of the experiment, in order to supply an adequate quantity of air to the tube; and, as the experiment lasts only a few hours, the average quality of the gas made during the day cannot be ascertained. In short, I believe that this very ingenious apparatus of Mr. Valentin's is adapted exclusively to the laboratory, as it can only be used by an experimental chemist, and that it does not possess that practical working character required in a testing apparatus that is to be used rather by intelligent workmen than by men specially devoted to scientific pursuits.

"In conclusion, long consideration of the subject of the sulphur contained in purified gas has induced me to regard the simple apparatus of Dr. Letheby as the one which best fulfils the practical conditions of an instrument for testing the quantity of sulphur which, unfortunately, the progress of science has not yet succeeded in completely extracting during the manufacture of gas.

"Paris, April 15, 1868."

The Editor of the *Journal of Gas Lighting* appends the following note to this communication:—

"We are informed that Dr. Letheby made a large number of experiments, in 1854, with an arrangement on the same principle as Mr. Valentin's, the products of the burnt gas being passed with an excess of atmospheric air through a mass of very fine platinum wire, at a temperature a little below redness; and the results were so unsatisfactory that the process was abandoned. Dr. Letheby also endeavoured to estimate the sulphur by passing the gas through a glass tube filled with small pieces of caustic baryta (obtained from the nitrate by ignition), and kept at a red heat; but as the process could not be continued for 24 hours—the time necessary for a fair analysis—this also was abandoned."

ARSENIC IN SUBNITRATE OF BISMUTH.

Dr. Gunning calls attention to the fact, that the metallic bismuth of commerce nearly always contains arsenic. He found on testing six different samples of the subnitrate of bismuth, as sold by respectable chemists at Amsterdam, that each of these samples contained arsenic; he instituted some experiments to find a ready mode of getting rid of the arsenic, and states that if even the metallic bismuth applied for the making of the subnitrate were contaminated with arsenic, the latter can be eliminated if to the nitric acid solution of the metal, just so much water is added as will suffice to produce a slight precipitate; this will contain all the arseniate of bismuth with a comparatively small proportion of subnitrate; the fluid has to be left until the precipitate has fully subsided, and the clear supernatant liquid may then be decanted, and on further addition of water the subnitrate of bismuth precipitated free from all arsenic. The *rationale* of this process is that the arseniate of bismuth is far less soluble in somewhat dilute acid, while still more than sufficient acid is present to prevent the nitrate of bismuth becoming converted into sub- or tris-nitrate, as it is called. It is true that by following this mode of manufacturing subnitrate of bismuth some loss is experienced of subnitrate; but the first sediments, if accumulated, may be boiled with a solution of caustic soda, whereby arseniate of soda is obtained, and oxide of bismuth, which latter of course can serve again for the preparation of the subnitrate with due care. In a medico-legal point of view, the fact that preparations of bismuth as applied in medicine may contain arsenic is of great importance.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 21.

Dr. **Warren de la Rue**, F.R.S., &c., President, in the Chair.

The minutes of the previous meeting were confirmed, and the names of candidates for admission into the Society were read:—For the first time, Mr. H. B. Riddell, late of the Indian Civil Service, 9, Stratton Street, Piccadilly; and Mr. Samuel Alexander Sadler (at Messrs. Chance's Chemical Works), Oldbury, Birmingham. For the second time, were read the following names:—Henry Chance, M.A., Glass Manufacturer, Birmingham; William B. Miller, assayer, Royal Mint, Sydney; and William Hustler, Mining Engineer, Rosemerryn, Falmouth.

Dr. W. J. Russell described "*Some Experiments on the Application of the Measurement of Gases to Quantitative Analysis.*" The author has made experiments for the purpose of testing the accuracy of a system of measurement, instead of weighing, in a variety of analytical operations wherein gases are evolved. The illustrations given in the paper have reference to the treatment of sodium and calcium carbonates with sulphuric or hydrochloric acid; manganic peroxide, decomposed by a mixture of oxalic and sulphuric acids; and, finally, zinc, magnesium, and other metals evolving hydrogen when undergoing solution in diluted acids. The apparatus employed consists of a eudiometer or measuring tube having attached to the top, at right angles, a flexible india-rubber tube, cemented on tightly with marine glue. This tube serves to connect it with a small flask, or bulb, in which the analytical operation is conducted, the acid being kept separate from the carbonate or metal in the usual manner (by a glass tube within), until all is ready for starting the decomposition; the gas and air measured before and after the experiment gives by difference the amount of hydrogen, carbonic acid, &c., evolved. India-rubber has been found to absorb notable quantities of the last-named gas by long contact, but the error from this and other sources proves to be very trifling, the following results having been obtained by Dr. Russell:—

CO_2 from carbonate of soda—		
Theoretical quantity	41·509	per cent.
Mean of eight experiments ..	41·533	"
Mean of other five experiments	41·431	"
CO_2 from calc spar—		
Theoretical quantity	44·000	per cent.
Mean of 13 experiments (HCl)	43·719	"
" 9 " (") ..	43·812	"
" 5 " (") ..	43·736	"
" 5 " (HNO_3)	43·924	"
Manganese ore—		
I. MnO_2	58·156	per cent.
II. "	58·101	"
Hydrogen from zinc foil—		
Theoretical amount	3·0769	per cent.
Pure—mean of 3 experiments ..	3·0757	"
Ordinary ditto	3·0504	"
Hydrogen from magnesium foil and ribbon—		
Theoretical amount	8·333	per cent.
Pure—one experiment	8·281	"
Ordinary—mean of 4 experiments	8·265	"

The **President**, in returning a vote of thanks to Dr. Russell, took occasion to remark that the experience of microscopists confirmed the statement relative to the permanent character of a junction made between glass and marine glue.

Dr. A. W. **Williamson** considered that the foregoing would be an exceedingly valuable addition to our methods of analysis, and no doubt capable of extension. As a rule, the process of measurement can be conducted with greater accuracy than by weighing; for whilst we could not weigh closer than one-tenth of a milligramme in our best balances, it was possible to measure volumes of gas within one-hundredth part of a cubic centimetre.

Mr. W. H. **Perkin** then read a paper, entitled "*Observations upon the Combining Powers of Carbon.*" The author addresses himself to the inquiry whether all four affinities, or combining units, of carbon are of equal value, and examines with this object the constitution of a great number of carbon compounds both simple and complex. Mr. Perkin concludes that the combining units of carbon are arranged in two pairs of very widely different chemical values, and proposes to indicate this difference in formulæ by drawing two thick lines for the stronger, and two thin lines for the weaker affinities. He deduces this conclusion from the fact that iodoform loses but two out of its three atoms of iodine when acted upon with bromine, or distilled with chloride of mercury, thus:—

$$C\left\{\begin{matrix}I\\I\\I\\H\end{matrix}\right. + BrBr = C\left\{\begin{matrix}Br\\Br\\I\\H\end{matrix}\right. + II.$$

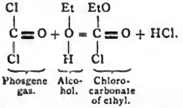
and

$$C\left\{\begin{matrix}I\\I\\I\\H\end{matrix}\right. + HgCl_2 = C\left\{\begin{matrix}Cl\\Cl\\I\\H\end{matrix}\right. + HgI_2.$$

In a similar way disulphide of carbon, when attacked by chlorine, gives an intermediate product, thus:—

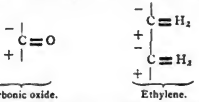
$$\text{C}\begin{cases}\text{S}\\\text{S}\end{cases}+\text{Cl}_6=\text{C}\begin{cases}\text{Cl}_2\\\text{S}\end{cases}+\text{SCl}_4.$$

Mr. Perkin's views may be well illustrated by quoting another example, one of many described in his paper, thus:—



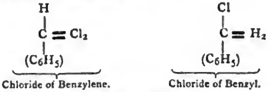
$$\underbrace{\begin{array}{c}\text{Cl}\\|\\\text{C}=\text{O}\\|\\\text{Cl}\end{array}}_{\text{Phosgene gas.}}+\underbrace{\begin{array}{c}\text{Et}\\|\\\text{O}\\|\\\text{H}\end{array}}_{\text{Alcohol.}}=\underbrace{\begin{array}{c}\text{EtO}\\|\\\text{C}=\text{O}\\|\\\text{Cl}\end{array}}_{\text{Chlorocarbonate of ethyl.}}+\text{HCl}.$$

In the instances of carbonic oxide and ethylene, where the carbon affinities are not satisfied, the author suggests that in these bodies the stronger units are in combination with O and H_2 respectively, and the weaker pairs are neutralised by virtue of a kind of polarity, thus:—



$$\underbrace{\begin{array}{l}-\,|\\\quad\text{C}=\text{O}\\+\,|\end{array}}_{\text{Carbonic oxide.}}\qquad\underbrace{\begin{array}{l}-\,|\\\quad\text{C}=\text{H}_2\\+\,|\\-\,|\\\quad\text{C}=\text{H}_2\\+\,|\end{array}}_{\text{Ethylene.}}$$

The following experiments were shown by Mr. Perkin. Some dry oxalate of silver in a test tube was brought into contact with chloride of benzylene; when the action had commenced, at first slowly, a delivery tube was adapted and the evolved gases collected over water were shown by appropriate tests (potash absorption and inflammation of the residue) to consist of a mixture in equal volumes of carbonic acid and carbonic oxide. A comparative experiment was likewise made for the purpose of showing the difference in the action of sodium alcohol upon chloride of benzylene, and chloride of benzyl in alcoholic solution, both being heated by immersion in boiling water; the latter soon gave a copious deposit of chloride of sodium, whilst the contents of the other tube remained clear. The difference in the behaviour of the two bodies was explained by assuming that the chlorine was tied to the carbon by a weak bond in the chloride of benzyl, and by a strong double union, or affinity, in the case of the chloride of benzylene. Their constitution was thus sketched:—



$$\underbrace{\begin{array}{c}\text{H}\\|\\\text{C}=\text{Cl}_2\\|\\(\text{C}_6\text{H}_5)\end{array}}_{\text{Chloride of Benzylene.}}\qquad\underbrace{\begin{array}{c}\text{Cl}\\|\\\text{C}=\text{H}_2\\|\\(\text{C}_6\text{H}_5)\end{array}}_{\text{Chloride of Benzyl.}}$$

The author concludes his paper by stating his views in the form of three propositions:—

1st. That the units of combination possessed by an atom of carbon consist of two pairs of greatly different values.

2nd. That the units of each pair are chemically of slightly different values; and that they appear to possess some kind of polarity, thus rendering it intelligible that two units of combination in one atom may neutralise each other.

3rd. That in poly-carbon compounds the weak units of combination of one atom of carbon may unite with the strong units of a second atom.

The PRESIDENT moved a vote of thanks to Mr. Perkin, and invited an expression of opinion from Sir Robert Kane, Dr. Williamson, and others whom he saw in the room.

D. A. W. WILLIAMSON demurred in accepting the view put forward by Mr. Perkin, and considered that this was an example of the grave errors sometimes committed by chemists, when attempting to follow in the path of Kekulé without heeding the pitfalls against which that author had specially warned them at the outset. It was a mistake to assume that when one atom of hydrogen in marsh gas was replaced by chlorine, and the new body, CH_3Cl, came in turn to be attacked by chlorine, that because a greater difficulty was experienced in the second replacement a different degree of affinity must necessarily be exerted between the carbon and one or the rest of the original hydrogen atoms. The fact was that at the first stage the properties of the body were entirely changed, and we have afterwards to deal with a new system, and the effects produced in the two cases have, therefore, no assignable relation one to the other. Taking a simpler case, that of water, H O H. When attacked by sodium a hydrate was produced, H O Na, which exhibited new properties; and when we proceeded further to replace the remaining atom of hydrogen in this hydrate it could not be said that we were at that moment dealing with water, nor could it be inferred that because one H left before the other it was originally held in weaker union with the oxygen. Professor Williamson instanced other examples of hydrogen replacement, So_2 for H_2 in the case of hydrated sulphuric acid being formed from two atoms of water; and, then, whether one or both of the remaining hydrogen atoms were replaced by potassium, it was impossible to observe any difference, or imagine any distinction, between the two atoms of hydroxyl, or of hydrogen, in these compounds. The speaker objected to the use of the words, "atomicity" and "bond," and said that although Kekulé protested at first against a wrong use being made of these terms, his mind seemed afterwards to have become warped by constant misapplication of them on the part of others, for he had come at last to use them himself in the sense against which he formerly objected.

Dr. ODLING agreed heartily with all that Dr Williamson had said, but still felt thankful to Mr. Perkin for having brought the subject forward for discussion. The hypothesis which asserts that an atom of carbon is provided with bonds of which each has a specific function is not new, having been already described in "Watts's Dictionary of Chemistry" and discussed by Erlenmeyer and others. It seemed to be necessary to wait for facts: Dr. Williamson had alluded to the two chlorides of methyl formerly supposed to exist, and some chemists believed there were two bromides of ethyl. Referring to Mr. Perkin's illustrations, the four bonds of carbon instead of being extended at right angles would, if written in a straight line, be shown thus $=\text{C}\overset{=}{=}$, but in attempting to explain the constitution of carbonic oxide there was nothing to show whether the oxygen atom stood on the right hand or left; in either case there would be a hypothetical copulation of unsatisfied affinities.

Dr. HUGO MULLER disputed the inferences drawn from the asserted impossibility of converting the chloride of benzylene into a tri-chlorine compound, the fact being that this could be accomplished by the continued action of chlorine.

Mr. PERKIN, in reply, reminded his hearers that he had purposely abstained from the use of the word "bond," and employed throughout his paper the term "combining unit." Chloride of benzylene was produced by the action of pentachloride of phosphorus upon the oil of bitter almonds, and he was not aware that the chlorination of this product could be pushed further. He still wanted an explanation of certain facts; for instance, when the vapour of bichloride of carbon is passed through a red-hot tube it gives up part of its chlorine; but why does this happen if the combining units are of equal value? and again, why does carbon rob carbonic acid of half its oxygen?

Dr. ODLING said it would be easier to take a hundredweight out of the possession of a man who was loaded with two, than if he were holding but one.

Mr. JOHN PARNELL then read a short paper, and exhibited a few experiments "*On the Reducing Action of Peroxide of Hydrogen and Carbolic Acid.*" The leading feature of this communication was a new colour-test for the detection of peroxide of hydrogen, which was shown to be much more delicate in its indications than the ordinary ethereal solution of chromic acid. The "ten-volumes preparation" of Messrs. Garden and Robbins was diluted with thirty times its bulk of distilled water, and 1-10th c.c. only taken for the experiment. This was added to a mixture previously made of aqueous carbolic acid and ferrous sulphate, when a permanent green colouration was produced in the cold. When, however, the ferrous sulphate and peroxide of hydrogen were previously mixed, only the usual violet colour, as with ferric salts, appeared on addition of the carbolic acid. The results obtained by varying the circumstances were shown at the meeting, and a somewhat remarkable reaction with the chloride of aluminium was described.

Dr. Hugo Muller attributed the results observed to the production of oxyphenic acid, which is a powerful reducing agent; and the pink colour noticed in the case of chloride of aluminium may possibly have been due to the formation of rosolic acid.

A vote of thanks having been given to the author, the President adjourned the meeting until Thursday, 4th June, when Mr. Chapman will read papers "*On the Artificial formation of Pyridine;*" "*On a New Reaction for the formation of Isomeric Cyanides;*" and another short note. Dr. B. H. Paul will describe "*A mode of Testing Mineral Oils used in Lamps.*"

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, April 14th, 1868.

R. Angus Smith, Ph.D., F.R.S., Vice-President, in the Chair.

Mr. Wm. Brockbank and Mr. A. Brother were appointed Auditors of the Treasurers accounts.

Mr. S. Broughton said that, on recently observing with high powers a group of fine spots on the sun, one of which was of considerable magnitude, it occurred to him to remove the dark glass, and by keeping the eye much beyond the focus of the heating rays, and at such a distance that the spot almost filled the apparent field of the eye-piece, to see if any phenomena could be observed different from those seen through the dark glass.

The spot was at once seen to be of a dark blood red; but thinking this perhaps might be from the strong contrast of colour, he attached a disc of plaster of Paris to the telescope, and projected the image of the spot on it. On looking at this with a common pocket magnifier, the image was observed to be a dark blood red, although the observatory was not darkened, and the disc merely shielded from the direct rays by an intervening opaque substance.

If these observations are confirmed, it will corroborate the opinion long held that the spots are not black, but appear so by contrast, and, as it would seem, from the intervention of the coloured glass.

BAVARIAN ACADEMY OF SCIENCES.

At a meeting of the Bavarian Academy of Sciences, held on the 10th of May, the President, Baron von Liebig, delivered a lecture "*On Fermentation and the Source of Muscular Power.*" It was shown that Pasteur's celebrated discovery of the increase and propagation of the yeast fungi in a mixture of tartrate of ammonia, sugar, and yeast ashes, rested on a palpable error.

Liebig explained that, according to his analysis, the chief constituent of the yeast was a substance similar to the caseine of milk, containing nearly 1 per cent of sulphur, and recognisable when in putrefaction, even by the unprofessional, through the odour of rotten eggs.

As the materials which Pasteur employed for the growth of the yeast fungi, contained no sulphur, it follows that his assertion of the increase of the yeast fungi in the mixture of the said substances is simply an impossibility.

The proof adduced by Pasteur, viz., that the ammonia contained in his mixture disappeared and was used for the nourishment of the fungi, is characterised by Liebig as a superficial observation.

Pasteur overlooked the fact that his mixture contained soluble and insoluble phosphates, due to the yeast ash, and that on expelling the ammonia with caustic magnesia the well-known phosphate of ammonia and magnesia must be formed, and that, hence, the very means he employed to ascertain the amount of ammonia rendered the solution of this question impossible. The ammonia, then, which disappeared, had not been employed in the growth of the fungi, but simply had entered into a chemical combination whose formation Pasteur had overlooked.

It has been observed that fresh pure beer-yeast left to itself, in the presence of water, disengages carbonic acid and produces alcohol. Liebig found that the power of yeast to excite fermentation is retained as long as this process is going on; at its close putrefaction sets in.

Liebig regards this process as a vital act in the interior of the cell, and as the immediate cause of the action of yeast in the fermentation. When a solution of sugar comes into contact with the yeast cell, the inner decomposition of the latter is retarded, and the molecules of sugar in contact with the cell are decomposed.

One hundred parts by weight of yeast left to themselves furnished 9·18 per cent of alcohol. Pasteur has assumed that this alcohol is produced from the cellulose of the yeast, which had changed itself into sugar. If this assumption were true, the cellulose ought to disappear entirely: it remains, however, unaltered behind.

During the formation of alcohol no trace of ammonia is generated. As some of the most remarkable products of this vital process, Liebig mentioned leucine and tyrosine, and a nitrogenous substance containing a certain amount of sulphur.

With regard to the investigations of Fick, Wislicenus, and Frankland, which have been regarded by many as a proof against Liebig's theory of the mode in which muscular power is generated, Liebig remarked that they rest upon imperfect conceptions of the nature of the organic process involved. It was just as impossible by the combustion of dried muscle to calculate its efficiency in the living body (the assumption of these physicists) as it was by the combustion of a dried bee to estimate the work which it accomplishes in the flight of many hours, carrying the weight of its own body several miles. The muscle in the living body acts like the apparatus in a watch, which gradually expends the power stored up in it. A freshly-severed frog's leg represents an apparatus of this kind with an escapement, while the newly-removed heart of the same animal corresponds to one without escapement; the frog's heart beating for hours together, just as in the living body, while the frog's leg moves as soon as an irritant sets it for a moment free from the escapement; and if small weights are hung on them, it is possible to obtain work from a pair of severed frog's legs, that is, the weight will again and again be alternately raised to a certain height, without blood or the supply of any kind of nourishment.

FOREIGN SCIENCE.

Paris, May 27, 1868.

A case in medico-legal chemistry.—Employment of sulphocyanides in toning and fixing photographs.—Derivatives of the radical silico-allyl.

A case in medico-legal chemistry, tried at Versailles, is worthy of some attention. Lucifer matches, it was said, had been used in poisoning the victim. The chemist stated that after a scrupulous examination of the exhumed matter (interred two years) he had failed to detect phosphorus, probably volatilised or oxidised long ago, but he had separated several pieces of melted sulphur, which he exhibited. From these facts he concluded that chemical matches must have been present, for these traces of sulphur, though very small, could not occur in culinary or pharmaceutical preparations. The question was then put—did he not know that sulphur similar to that which he had exhibited was found in deposits of fecal matter which had undergone a certain fermentation in the air? and upon this point, the finding of sulphur perfectly crystallised or in concreted masses in the old deposits in the sewer of Montfauçon, was cited; the specimens of sulphur here referred to are preserved in one of the public museums. Great doubt was thus thrown upon the source of the sulphur; indeed, judging from the chemist's evidence, he would appear to have argued farther than the experimental data justified him in doing. The prisoner was acquitted.

At a meeting of the Société de Photographie, M. Civiale made some observations upon the employment of sulphocyanides in toning and fixing. He stated that in the summer of 1867 he fixed about 700 positive proofs by means of potassium and ammonium sulphocyanides. A print, one half of which had been protected from the light, the other unprotected, and which had been exposed for three months, showed only an uniform tint.

MM. Friedel and Ladenburg communicated recently a paper, "on some derivatives of the radical silico-allyl," to the Academy of Sciences. The formation upon heating 3 molecules of silicic ether and 1 molecule of chloride of silicium, to 150°, during an hour, of a product named by MM. Friedel and Crafts, monochlorhydrine silicic-ethyl, and containing $SiCl(C_2H_5O)_3$, has already been pointed out. The same body can be obtained easily, in adding, drop by drop, 3 molecules of absolute alcohol to 1 of chloride of silicium, submitting the product to fractional distillation, and collecting that which distils at about 156°. The reaction taking place is expressed by the following equation:—

$$SiCl_4+3C_2H_5O,H=SiCl(C_2H_5O)_3+HCl.$$

A very advantageous yield is thus obtained. Monochlorhydrine silicic-ethyl does not react upon zinc-ethyl, even upon boiling; but the addition to the mixture of a few fragments of sodium, with the aid of a gentle heat, commences a reaction which, if not moderated, may become very energetic. There is produced an abundant disengagement of gas; at the commencement of the reaction this gas is principally composed of chloride of ethyl, afterwards the chlorine disappears, and the gases are simply hydrocarbons (ethyl and hydride of ethyl). The sodium becomes covered with zinc in powder, and finally disappears; the liquid then contains zinc and chloride of sodium. The disengagement of gas having ceased, the operation is arrested, and the product distilled. The major part passes over, after several fractionatings, between 159 and 162° when only 1 molecule of zinc-ethyl has been used for 2 molecules of monochlorhydrine. Analysis assigns to this body the formula $SiC_2H_5\ (C_2H_5O)_3$, which is confirmed by the number found for the vapour density; experiment gave 6·92, while theory requires 6·65. The density has been found to be 0·9207 at 0°. Evidently in monochlorhydrine, 1 atom of chlorine has been replaced by the group C_2H_5. The body thus produced is an ethereal liquid, possessing an agreeable odour, resembling that of silicic ether. It is insoluble in water, but soluble in alcohol and ether in all proportions. Moisture transforms it gradually into alcohol, and products boiling at a higher temperature, which are doubtless, say the authors, polysilicates analogous to those which silicic ether gives. Ammonia and even alcoholic potash do not effect complete decomposition; the body partakes of the stable nature of silicium-ethyl, and is only oxidised by nitric acid above 200°. Concentrated sulphuric acid decomposes it instantaneously. With very concentrated hot potash a lively reaction is produced, and the ether is decomposed rapidly, two layers being formed, both soluble in water, which only separates some oily globules. When the solution is neutralised by hydrochloric acid, or better with chloride of ammonium, a white flocculent precipitate is produced, resembling silica. This precipitate collected on a filter and dried over sulphuric acid, burns and blackens when heated on platinum foil; it is soluble in potash and reprecipitated by hydrochloric acid. The solution feebly alkaline gives with nitrate of silver a precipitate white or yellowish soluble in ammonia, and containing a silico-carbonated acid with oxide of silver. By making a combustion of the acid in a current of oxygen, numbers were found leading to the formula $SiC_2H_5O_2H$ with a small quantity of silica; the body has not yet been obtained in a state of absolute purity. Potash has then split up the ether afresh according to the equation $SiC_2H_5(C_2H_5O)_3 + 2\ H_2O = SiC_2H_5O_2H + 3\ C_2H_6O$. The new ether has received the name of tribasic silicopropionic ether.

CORRESPONDENCE.

NAMES *VERSUS* SYMBOLS IN TEXT-BOOKS.

To the Editor of the Chemical News.

Sir,—As you have opened your columns to letters upon the difficult subject of teaching science, I beg to be allowed space for a few remarks upon the Names *versus* Symbols used in the text-books on chemistry recommended to beginners.

It may be taken for granted that what is generally understood as the binary theory of salts is the one adopted in this country to express the composition of chemical compounds. That this theory is imperfect we are all doubtless well aware, but at the same time its imperfection is of no consequence in practical teaching, since it is consented to by chemists because it is as good and useful a theory as any with which we are at present acquainted. I take the chief point in this theory to be, that the symbolic representation of all chemical compounds shall be analogous to that of common salt—NaCl.

If the above be true it is the duty of every teacher of chemistry, to endeavour by all the means at command, to suit his nomenclature and method to the theory he is about to communicate.

Are the text-books, or rather is the nomenclature they contain, in thorough accord with the theory they profess to teach?—I think not.

The reason why they are not, is, I believe, in great measure due to the fact that writers of text-books and teachers of the science have never worked in unison; have never come to any kind of agreement as to the terms best adapted to express certain facts. Each has taken his own view of the subject, and written what seemed sufficient to suit his own purpose. They have never, I think, duly considered the influence of old ideas upon persons who do not make chemistry their chief study, nor have they clearly stated the entire change which has taken place. Thus we have a mixed nomenclature, giving rise to conflicting notions upon what, whether right or wrong, should be distinctly stated.

I do not propose to lay before you anything new, neither do I pretend to unfold any panacea for our evils; I am fully alive to the difficulties of the problem I wish to solve, and am aware that many great and scientific men are, and for a long time have been, occupied with the revision of our nomenclature, and it is only my long and sad experience in teaching, which induces me to venture in bringing the subject before you.

There can of course be no objection to a chemist using any system of nomenclature in a scientific paper intended for chemists, or to the employment of any formulæ, not excepting the graphic, or even to his mixing different names and formulæ for the same substance; but in a text-book intended for beginners, we ought to confine ourselves rigidly to one, and heaven knows the labour of teaching only that one, to the generality of students.

The particular terms in our nomenclature to which I wish to draw attention, are those of acid, base, salt and radical.

Our idea of acid is borrowed from the taste of vinegar and unripe fruit; it has grown up with us from the nursery, and is an inheritance carrying with it its own lesson and associations. In chemistry, do we teach boys that all acids are sour? Certainly not. Do we mean to state that an acid is a body capable of uniting with a base to form a salt?—Certainly not! Do we mean to state that an acid is a body possessed of diametrically opposite properties to a base?—No. But many boys cling most pertinaciously to the idea, that lump sugar is the great representative of the class of bodies called bases. Do we imagine that mere words are sufficient to make a boy believe that flint is an acid, or that water is a most potent and active dibasic acid?—We may try, but we don't succeed. The only way to convince him is, in the laboratory, to melt a carbonate, and when it is calmly fusing to add dry flint, and show him the escape of carbonic acid, and even then while admitting the fact he does not believe you, but says "you call it an acid." Again, water, which far more deserves the name of acid than flint, does not receive that appellation. It is only hinted at occasionally and indirectly in our text-books. But if H_2SO_4 is a bibasic acid, because it has two proportions of replaceable H; then H_2O is a dibasic acid for the same reason; and if H_2SO_4 is to be called dihydric sulphate on account of the two proportions of replaceable H, then H_2O is dihydric oxide for the same reason.

But who, in a laboratory, would ever dream of asking his fellow for the dihydric sulphate; or tell his pupil to add an additional proportion of distilled dihydric oxide to his solution, &c., &c.? If, then, from old association, we never apply these new names in practice, ought we not to do our utmost to save beginners from the danger of receiving wrong ideas? Now, it is granted on all hands, that to give exact principles to beginners you must use clear and definite language, thus supplying them, as far as possible, with correct means from which to form those ideas; and further, that until you get a youth to think chemistry in correct terms, you cannot expect him to produce exact answers; and even when correct terms are given, I am afraid, from past experience, it is hopeless to expect a boy to use them unless he finds others doing so too.

In our class-books we find such a term as dihydric sulphate given to the body H_2SO_4; but in the same page it is called sulphuric acid, and in a third place, oil of vitriol. So, also, authors who adopt hydric chloride as the proper name for HCl, almost invariably in the text write about hydrochloric acid. Is it fair to ask a boy in his reading to think in such terms as hydric chloride, and to be examined in them, while in his text-book, and in the laboratory, he has practically never heard it called anything but hydrochloric, or even muriatic acid. These names matter nothing to the chemist, neither do the formulæ, whichever, say of the 20 recognised ones, you choose to use for common vinegar. The chemist would most likely know what you meant, without caring much for your names or symbols; but not so the boy, or the beginner. To such a one, a name means something, and a formula is supposed by him to be a sort of representation of the composition of a body. He requires therefore, first, a formula for vinegar to be given without comment that it is wrong, or that there are 19 others, all of which, according to their authors, are more correct than the one he is learning. Further, all the recognised text-books should give the same recognised formula for the same body, leaving it to more advanced books to deal with the differences of opinion respecting them. If boys are to believe in chemistry, they must find the same names and the same facts recorded in all their text-books; and this at present is not the case. It is therefore proposed, for the consideration of all persons who have the school-teaching of chemistry at heart, whether it would not be better to exclude altogether the terms acid and base from elementary text-books.

Should you, Sir, deem these remarks worthy of a place in your valuable Journal, I shall be happy, at some future time, to consider the other terms, namely, salt and radical.

The present letter is, I fear, already too long to discuss them now.—I am, &c.,

Thomas Wood, Ph.D., F.C.S.

Laboratory, 23, Grove Street,
Lisson Grove, N.W.

SCIENCE TEACHING IN SCHOOLS.

To the Editor of the Chemical News.

Sir,—The excellent letter of Mr. Tomlinson in your Journal of May 22nd, must be my excuse for troubling you with a few lines upon the subject of Science Teaching in Schools.

I have, on the average, 150 pupils going through the courses of chemistry and physics necessary for the various competitive examinations during each six months, and as each member attends two lectures in the week, I may perhaps be allowed, after nearly seven years experience, to add my tribute to Mr. Tomlinson's assertions.

It is, in most cases, next to impossible to impart the theories for the production of heat or electricity, for example, to any except the senior divisions; and I most cordially agree with Mr. Tomlinson, "to say nothing of theory," except in special cases where the mind is well prepared by age and previous scientific training in lower classes to receive such impressions. I believe the true system to be, (1), gradually to rear the mind of the young student, commencing, for example, with the most elementary considerations of pneumatics and general properties of matters. (2). He should, as Mr. Tomlinson justly observes, be thoroughly instructed in that most difficult process of taking notes, and particularly of each experiment, and in some cases made to draw the essentials of the apparatus used. (3). A *viva voce* examination should be held upon the subject of the previous lecture; this I believe of great good, for by it you find out the weak points of which nine out of ten pupils are for some reason or other ashamed to tell you; and in junior classes it is well to invite questions after every experiment. (4). Scientific terms should be avoided as far as possible at the commencement, and even when they are used should be most thoroughly explained.

A course of elementary technology, such as our leading manufactures, illustrated by specimens and diagrams, and experiments when possible, I find of much value and greatly appreciated.—I am, &c.,

T. Bloxam.

The College, Cheltenham.

MISCELLANEOUS.

British Association for the Advancement of Science.—The meeting for the present year will commence in Norwich, on Wednesday, the 19th of August next, under the presidency of Joseph Dalton Hooker, Esq., F.R.S., D.C.L., &c., Curator of the Royal Gardens at Kew. The fact that Norwich has never before been visited by the British Association, the character of its manufactures, the highly interesting geological features and archæological remains in the surrounding district, with a hearty desire worthily to receive the Association, will combine, we trust, to make the meeting thoroughly interesting and successful. Through the liberality of various public bodies and private individuals, the Committee have obtained excellent accommodation for the various meetings of the Association; a subscription has been raised to defray local expenses; the offers of private hospitality have been numerous; special invitations have been given to the corresponding members, and a large number of distinguished foreigners; and every effort will be made to receive and heartily entertain visitors to the meeting. The Reception Room, at the Masonic Hall, Theatre Street, Norwich, will be open on Monday, August 17, at 12 o'clock, for the sale of tickets, and for supplying information to visitors. The local secretaries are—Donald Dalrymple, Esq., Rev. Hinds Howell, and the Rev. Joseph Crompton. Communications intended for presentation to the sections are expected to be forwarded before August 15th, addressed either to G. Griffith, Esq., Assistant General Secretary, 1, Woodside, Harrow, or to one of the local secretaries at Norwich, and to be accompanied by a statement whether the author will be present, and on what day, so that the business of the Association may be satisfactorily arranged. The *Opening Address* will be delivered in the Drill Hall, on Wednesday evening, the 19th of August, at eight o'clock, by Joseph Hooker, Esq., F.R.S., D.C.L., &c., President Elect. *Soirées* will be held in St. Andrew's Hall, on the evenings of Thursday, the 20th, and Tuesday, the 25th of August. *Evening Lectures* will be delivered in the Drill Hall, on Friday, the 21st, and Monday, the 24th of August, at half-past eight o'clock. Various *Excursions* (geological, archæological, and ethnological) have been arranged to take place on Thursday, the 27th of August, to Cromer and its district, to Hunstanton, to Holkham, Castle Acre, Diss, Hoxne, Thetford, &c., full details of which, with times of trains, will be published in due course. Minor excursions, within a short distance of Norwich, are in course of arrangement, and will be notified at the time of meeting. A post office will be opened at the Reception Room, Masonic Hall, Theatre Street, for the convenience of members, and to which members may have their letters directed. The Great Eastern, Great Northern, Great Western, North Western, and Midland Railway Companies will convey members, on the production of a pass ticket, at a fare and a half for the return journey. Trains between Norwich, Yarmouth, and Lowestoft will run frequently during each day.

Increase in the Quantity of Carbonic Acid met with in Air, narrow streets, and lanes.—Professor Dr. Gunning records a series of experiments concerning the quantity of carbonic acid gas contained in the atmosphere of the City of Amsterdam. While the average of carbonic acid gas found in a most densely populous part of that city was only 4·13 vol. in 10,000 vols. of air, it appeared that the air in the thoroughfare called *Halsteeg*, and taken at 3 meters height above the pavement, contained from 4·9 to 5·4 vol. of carbonic acid gas in 10,000 vol. of air. The width of the thoroughfare alluded to is about the same as that of Birchin Lane, Lombard Street, E. C. Dr. Gunning advocates the proposed widening of the above-named thoroughfare as necessary, also, on sanitary grounds.

Production of the Precious Metals.—Mr. J. Ross Brown, in his report to the Secretary of the United States' Treasury on the mineral resources of the States and territories west of the Rocky Mountains, says that a great increase in the production of both gold and silver is probable. In California, Australia, and Siberia gold mining is now conducted under many disadvantages. In the two former, wages and interest are exceptionally high, and in all there is a lack of that thorough knowledge and of those economical modes of working which can only be adopted by a generation educated to the business and devoted to it as a life-long occupation. In Spain and Brazil, which were once very rich in gold, and would probably pay for hydraulic washing, there must be numerous quartz veins that are now untouched. These will be made productive. The Andes and the Altai will be explored with care, and hundreds of veins as rich and large as those of Potosi and Guanajuato will be found. Machinery will be improved, so that tunnels or adits large enough for wagons can be bored five, ten, or twenty miles long, through high mountains, so as to pay for purposes of travel, and at the same time any lodes that may exist in the chain will be opened to a depth far below anything known in mining. The great lodes of the future will not be discovered by such antecedents as those which revealed Potosi, Cerro Pasco, Sombrette, Chanarcillo, and the best mines of Catorce. If veins like those could be found by chance, what will not the well-directed explorations of the future find? It is scarcely to be doubted that a large tunnel, commenced 1,500 feet above the sea level, on the western slope of the Sierra Nevada, at any point between 36° and 40°, would in the course of ten miles run through a multitude of rich lodes. We have reason to believe that when the great mountains were formed numerous large fissures, running in some places for hundreds of miles, were filled with auriferous and argentiferous quartz; and we fail to find them not because they are not there, but because they are covered with earth, and because the clambering hunter, the benighted wanderer, or the charcoal-burner, does not pull up the bush or does not light the fire in the right spot. A tunnel running through the Andes, commencing near Lima or Santiago, would reveal wonders; and the progress of mechanical industry is so marvellous that we are justified in hoping, if not in expecting, to see immense tunnels, fifteen or twenty miles long, cut through high mountain ranges.

Chlorous Anhydride and Benzol.—L. Carius. The formation of trichlorphenomalic acid is accompanied by the production of chlorbenzol and dichlorquinone, more especially if an excess of chlorous acid has been used (*Ann. Chem. Pharm.*, cxlii., 129). The author thinks that this is due to a reaction between chlorous anhydride and benzol, which he represents in the following two equations—

$$(1.)\ \text{Ȼ}_6H_6 + Cl_2\text{Ɵ}_3 = \text{Ȼ}_6H_4Cl_2\text{Ɵ}_2 + \text{Ɵ}H_2.$$

$$(2.)\ (\text{Ȼ}_6H_6)_2 + (\text{Ȼ}_6H_4Cl_2\text{Ɵ}_2)_2 + Cl_2\text{Ɵ}_3 = $$
$$= (\text{Ȼ}_6H_5Cl)_2 + (\text{Ȼ}_6H_2Cl_2O_2)_2 + (\text{Ɵ}H_2)_3.$$

As regards the properties of dichlorquinone the author confirms most of Städeler's statements, but finds that the compounds obtained from it by the action of potassic or baric hydrate are not the salts of an acid similar to dichlorquinonic acid, but compounds of dichlorhydroquinone, $\text{Ȼ}_6H_4Cl_2\text{Ɵ}_2$.—(*Ann. Chem. Pharm.*, cxliii., 315).

Obituary.—Professor Page.—Professor Charles G. Page, of the United States Patent Office, died on the 5th inst., after a lingering illness. He was the author of many important discoveries in electro-magnetism, and the inventor of an electro-magnetic motive-power engine, which attracted some attention from fifteen to twenty years ago. Prof. Page had for many years been chief examiner in the U. S. Patent Office, of the class termed "philosophical instruments," embracing all inventions in mathematics, mensuration and electricity.

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

830. C. Attwood, Wolsingham, Durham, "Improvements in the production or manufacture of steel and iron of a steelly character."—March 10, 1868.

835. F. Winser, Manchester, and J. Swindells, Kegworth, Leicestershire, "Improvements in the utilisation of the waste products arising from Esparto grass and other fibrous materials used in the manufacture of paper and other purposes.

836. F. Winser, Manchester, and J. Swindells, Kegworth, Leicestershire, "Improvements in the manufacture of sulphate of magnesia."—March 21, 1868.

855. B. Britten, Red Hill, Surrey, "Improvements in the manufacture of manure."—March 12, 1868.

861. M. Rowand, Lewisham, Kent, "Improvements in the treatment or preparation of the ingredients employed in the manufacture of fermented liquors."—March 13, 1868.

884. H. F. Griffiths, and A. Beard, jun., "Improvements in apparatus for puddling iron and steel."

891. W. E. Newton, Chancery Lane, "Improvements in the manufacture of illuminating gas in the distillation of hydrocarbons, and the making of gaseous fuel for heating purposes."—A communication from L. Stevens, Washington, Columbia, U.S.A.—March 16th, 1868.

901. W. E. Gedge, Wellington Street, Strand, Middlesex, "Improved fuel, by the use of which the kindling of fires will be greatly facilitated."—A communication from R. N. Legendre, Passage des Petites Ecuries, Paris.

909. W. E. Newton, Chancery Lane, "Improvements in producing steel and cast steel, and in furnaces or apparatus used therein."—A communication from A. Thoma, New York, U.S.A.

910. W. E. Newton, Chancery Lane, "Improvements in the process of preparing iron ore for smelting, and in furnaces therefor."—A communication from A. Thoma, New York, U.S.A.—March 17, 1868.

923. B. E. R. Newlands, F.C.S., Malvern Terrace, Charlton, Kent, "Improvements in treating and obtaining products from spent oxide of iron which has been used in gas works or otherwise, to separate sulphur from sulphuretted hydrogen, and in the purification of sulphur obtained from such oxide of iron."—March 18, 1868.

942. L. Encausse, Madrid, Spain, "Improvements in the application of remedial agents to the human frame, and in the apparatus employed therein."—March 19, 1868.

946. J. G. Tatters, W. Keeble, and B. Newbery, Plymouth, Devonshire, "Improvements in the preparation of cigars, and mode of lighting the same."—March 20, 1868.

NOTES AND QUERIES.

Extract of Madder.—In answer to the query of your correspondent, "W.B.," I beg to state that the extract of madder most in use now among the calico printers is that of M. Pernod, of Paris. Perhaps if he were to insert his query as an advertisement in a number or two of your Journal, he might be able to find some one who would be willing to communicate the process for a trifle.—R. S. Dale, B.A.

Aniline Green.—Cathartic Acid.—I make bold to trouble you with these queries:—1st. Iodine green for dyeing: what is it, and how applied? 2nd. Cathartic acid. It has been stated that senna owes its purgative properties to cathartic acid; if there have been any confirmatory experiments on the subject, might I trouble you for the process for the extraction of this acid?—Test Tube.

Vessel for Holding Nitric Acid.—Could any of your correspondents tell me of anything in which 1,200 gallons or so of dilute nitric acid (1 of strong acid, by measure, to 20 of water), can be boiled, the heat being applied by steam inside?—R. C. M.

Nitrate of Iron.—Your correspondent, "Constant Reader," desires a cheap mode of preparing nitrate of iron; he does not state, however, whether he requires the proto-nitrate or the per-nitrate, the former and latter both are applied in dyeing and calico printing. The proto-nitrate is best procured by so-called double decomposition, *i.e.*, by treating a solution of sulphate of protoxide of iron with the nitrate either of baryta, lime, or lead, the first-named salt being preferred on account of the great insolubility of the resulting sulphate of baryta; this salt, viz., nitrate of protoxide of iron, can be made also by treating iron filings with very dilute nitric acid, but the application of this process always gives rise also to the formation of ammonia, and consequently to nitrate of ammonia; moreover, it is almost impossible to evaporate the solution without causing the proto-nitrate of iron to become converted into per-nitrate of that metal. The per-nitrate of iron may be prepared—1st, by pouring over clean iron filings gradually nitric acid of commerce, previously diluted with its own weight of water, to keep the whole well cooled down by placing the vessel wherein the solution is taking place into very cold water, since otherwise the peroxide of iron which results of the action is precipitated, instead of being dissolved and combined with nitric acid, the affinity between nitric acid and oxide of iron being very feeble indeed; another plan is to dissolve hydrated peroxide of iron in nitric acid; another yet is to decompose 1 eq. of persulphate of iron by 3 eq. of nitrate of lead or nitrate of baryta. This latter mode is sure to give excellent and constantly good results, but is rather more costly; if, however, nitrate of lead is used sulphate of lead is obtained as a by-product which is of some value, while the precipitated sulphate of baryta, in case nitrate of baryta were used, is applicable in various ways as permanent white, which daily finds a more and more extended sphere of useful applications. For the preparation of persulphate of iron, which requires peculiar caution and manipulation, I must refer your reader to works on chemistry, or better, perhaps, on printing and calico dyeing.—Dr. A. A.

MEETINGS FOR THE WEEK.

Monday.—Royal Institution, 2. General Monthly Meeting.
Tuesday.—Royal Institution, 3. Dr. M. Foster, "On the Development of Animals."
Wednesday.—Geological, 8. 1. James Thomson, Esq., "On Some Carboniferous Corals." Communicated by Dr. P. Martin Duncan, Sec. G.S. 2. S. V. Wood, jun., Esq., F.G.S., "On the Pebble-beds of Middlesex, Essex, and Herts." 3. W. Topley, Esq., F.G.S., "On the Cretaceous Rocks of the Bas Boulonnais." 4. C. H. Weston, Esq., F.G.S., "Note on the Mendip Anticlinal.
Thursday.—Royal Institution, 3. Sir John Lubbock, Bart., "On Savages."
— Chemical, 8. Messrs. E. T. Chapman and M. Smith "On Isomerism in the Organic Cyanides;" and "On the Artificial Formation of Pyridine." Dr. B. H. Paul, "On Testing Mineral Oils used for Lamps."
— Royal, 8½.
— Royal Society Club, 6.
Friday.—Royal Institution, 8. Sir S. W. Baker, "On Abyssinia."
— Geologist's Association, 8.
Saturday.—Royal Institution, 3. Sir John Lubbock, Bart., "On Savages."

TO CORRESPONDENTS.

Mech.—Oil of Tartar is the name sometimes given to carbonate of potash which has deliquesced to an oily-looking liquid.

A Constant Reader, whose query on Nitrate of Iron was inserted a few numbers ago, is informed that a letter is awaiting him at our office.

Dr. T. R. Fraser, Halifax, Nova Scotia.—We regret that the article forwarded is unsuitable for our columns.

A Subscriber.—Charcoal from the ignition of white sugar would be the purest, but probably ivory black would answer your purpose best.

Chemicus Senior's letter has created much diversion. We shall probably print it. Will our correspondent favour us with his name and address, to add to it?

C. Hunter.—Careful addition of lime water, with free exposure to the air, would probably be found the best means of removing iron from the water.

P. C.—Bauxite is found at Baux, near Arles, in the south of France It contains about 55 per cent of alumina, the rest being oxide of iron, water, &c. For price, &c., apply to M. Morin, Salyndres, France.

Test Tube.—Two queries are inserted. The third was answered a short time back.

B. B. C.—Baillière, of Regent-street, have a collection of books on the subject. Consult these, and also the articles in Ure's and Watts's Dictionaries.

N. B. Rynard.—To give even a superficial outline of the subjects mentioned in your query would occupy several pages of the Chemical News. See the article in Watts's Dictionary.

B. W. Gibsone.—Communication received with thanks. We will endeavour to make use of it.

Errata.—In No. 442, "On Science Teaching in Schools," on page 243, line 43 from top, for "faults" read "faulty." On page 244, line 43 from top, for "heathers" read "breathes;" line 23 from bottom, for "trace" read "brace."

We are indebted to correspondents for the following periodicals containing reports and articles of Chemical or Scientific interest:—"The Chemist and Druggist;" "American Artisan;" "Mining and Scientific Press;" "Mining and Petroleum Standard and American Gas-Light Journal;" "Darlington and Stockton Times," May 16; "Le Moniteur Scientifique;" "Bulletin de la Société D'Encouragement;" "American Journal of Mining."

Communications have been received from The Council of the Society of Arts (with enclosure); G. F. Rodwell (with enclosure); C. Greville Williams, F.R.S. (with enclosure); J. Cliff; J. Smith, M.D., University of Sydney, N. S. Wales (with enclosure); Rev. B. W. Gibsone, M.A. (with enclosure); Dr. Lyon Playfair, F.R.S (with enclosure); Baron Von Liebig; C. J. Kaufmann; N. B. Rynard (U.S.A.); T. D. Reed, Canada; C. Hunter; H. J. Davies; W. Smallcome; A. Bird; J. W. Slater; H. McNaught; R. T. Dale, B.A.; R. Menzies; T. B. Fraser, M. D., Halifax, Nova Scotia, (with enclosure); McDougall, Bros. (with enclosure); Dr. Wood (with enclosure); H. Edwards; J. Parnell; Colonel W. H. Sykes, M.P.; E. F. Teschemacher; J. Denham Smith; J. Y. Buchanan; U. J. Kay Shuttleworth; Mawson and Swan; Albright and Wilson; J. Slessor; H. Jones; Townsend and Adams; J. Martin; Nicholson and Maule Dunn and Co.

THE CHEMICAL NEWS.

Vol. XVII. No. 444.

ON THE
ESTIMATION OF CARBON IN CAST IRON, WROUGHT IRON, AND STEEL.

ANALYSIS OF A CHROMIFEROUS WROUGHT IRON.

By M. BOUSSINGAULT.

M. Breche, an engineer, residing at Medellin, in Central America, sent me a specimen of cast iron derived from an oxidised iron mineral, reduced in a blast furnace fed with charcoal. It is white iron, in small plates, sp. gr. 7·45. Its hardness is great, and has been attributed to the presence of nickel. Upon dissolving the iron in hydrochloric acid a solution of a beautiful green colour is obtained. I soon saw that this colour was not due to nickel but to chromium.

Analysis gave :—

Combined carbon	4·40	per cent.
Graphite	—	
Silicium	0·75	"
Phosphorus	0·07	"
Sulphur	traces	
Arsenic	—	
Nitrogen	0·01	"
Manganese	0·84	"
Chromium	1·95	"
Vanadium	traces	
Iron	92·50	"
	100·52	

The estimation of the carbon having presented serious difficulties, I was induced to make a special study of this. I have been led to a process based upon the transformation of the iron into protochloride, without there being the least evolution of a gas capable of carrying off or burning the carbon. The agent which I use is bichloride of mercury. At first I worked in the dry way, and then with more success by the wet way.

The powdered iron is mixed with fifteen parts of bichloride. Add rapidly enough water to form a thin paste, which triturate for about half an hour in an agate mortar (when there is no objection to the introduction of a little silica, a glass mortar may be used). The diluted paste is introduced into a German flask, and kept for an hour at a temperature of 80° or 100°. Then throw it on a filter and wash with warm water. The protochloride of mercury after being well dried in the oven is put into a platinum boat and introduced into a glass tube communicating with a generator of *dry* hydrogen. Heat gradually up to a red heat in the current of gas. The protochloride is volatilised without decomposition; at least only very little mercury is reduced.

The volatilisation of the protochloride may equally well be effected in a current of nitrogen; but independent of the fact that it is not easy to keep up a sustained current of this gas, there will always be a suspicion of the presence of a little oxygen. In this respect hydrogen offers more security, especially if the device adopted at the *Ecole Normale au Conservatoire des Arts et Metiers* is employed, which consists in passing the dry hydrogen over a column of spongy platinum before it arrives at the tube containing the boat. The sponge retains the arsenic, and determines the disappearance of the oxygen which the hydrogen gas might contain.

In proportion as the protochloride of mercury disappears, the presence of carbon becomes manifest. Allow the boat to cool in a current of hydrogen, and then weigh it with the usual precautions. The carbon is voluminous, of a fine black; it lights and burns like tinder if the boat is heated a little. This is generally the case with carbon extracted from white irons, wrought iron, and steel. The graphite coming from grey cast irons only burns with the assistance of pure oxygen.

The carbon leaves an ash after its combustion. Before weighing this residue it must be heated red hot in a current of hydrogen.

From one gramme of white cast iron in large plates, I obtained—

Carbon.. .. .. 0·042 gramme.

After combustion there remained a crystalline residue having the appearance of silica. This residue heated in a current of hydrogen gas weighed 0·005 gramme, showing that the combined carbon weighed 0·037.

From one gramme of iron from a cementation furnace I obtained—

Carbon .. .. 0·009

After combustion—

Grey siliceous residue..	0·0015
Carbon	0·0075

The carbon extracted from cast irons, steels, and even from the better qualities of iron always leaves small quantities of ash. What is its origin? The silica of this ash when it comes from steel or wrought iron, in which it cannot be supposed to come from scoria, comes from silicide; but it does not represent the totality of this because the silicium in combination with the iron, being first transformed into chloride by the bichloride of mercury, passes by the action of water into the state of silica, of which one part, being soluble, is carried away in the washings, while another part, insoluble, is left with the protochloride of mercury. It is this insoluble silica which is found after the combustion of the carbon. I have proved this by experiment.

The metallic substances submittted to the action of bichloride of mercury should be reduced to powder. There is no difficulty in this in the case of white cast irons, for they pulverise easily. But when grey cast irons, steel, and especially wrought irons, are operated on, recourse must be had to the file to divide them, and this is an inconvenience on which I do not need to insist. A skilful analyst, M. Damour, has tried whether it is not possible to chlorinise the iron without this preliminary division. He placed, in a spiral formed of platinum wire, a small steel cylinder weighing 1·06 grammes, and then suspended it in water containing 15 grammes of bichloride of mercury. It was put in a warm place. Two days afterwards the steel cylinder had disappeared: the protochloride of mercury, &c., was collected on a filter, washed, dried, and weighed. It yielded—

Carbon, &c.	0·012
Residue of silica	0·003
Carbon	0·009

If the silicium combined with the iron is attacked in the cold by the chlorine of the bichloride of mercury, this is not the case with crystallised silicium. Upon triturating this with bichloride and water, so as to form a thin paste, no reaction is remarked. For the silicium to be attacked the operation must be conducted at an elevated temperature. 0·5 gramme of crystallised silicium, mixed with bichloride of mercury, was placed in a platinum boat, introduced into a glass tube, and raised to a red heat. The vapour of bichloride of mercury was then passed into the tube: all the silicium had disappeared in the form of chloride of silicium, and only a trace of silica remained behind in the boat.

carbonates of lime and magnesia, the greater portion of which is gradually deposited on boiling the water for half-an-hour. By reason of this softening of such water by boiling, temporarily hard water is considered to be less objectionable than water of the same degree of permanent hardness. My own experience leads me to the conclusion that the advantages of temporary over permanent hardness have been considerably over-rated. In reality, water used for domestic purposes is, even when used hot, either not heated to the boiling point, or is boiled for too short a time to remove more than a small proportion of its temporary hardness. Thus, water drawn from the kitchen boilers of a dwelling-house and of the Athenæum Club was usually almost as hard as the cold water with which they were supplied, as is seen from the following table:—

Date and Hour.	Hardness of Cold Water.	Hardness of Hot Water.
	°	°
Sept. 30th, 1867, 8 P.M.	14·6	13·6
Oct. 1st ,, 8 P.M.	14·4	13·9
,, 2nd ,, 8 A.M.	14·4	13·4
,, 3rd ,, 9 P.M.	14·6	11·6
,, 4th ,, 8 A.M.	14·6	7·6
,, 7th ,, 8 P.M.	14·4	11·7
,, 8th ,, 8 A.M.	14·4	12·1
,, 9th ,, 8 P.M.	15·4	14·3
,, 10th ,, 8 P.M.	15·9	11·9
,, 11th ,, 8 A.M.	15·9	8·4
,, 12th ,, 8 A.M.	16·1	11·9
Nov. 8th ,, 5 P.M.	18·7	18·4
,, 11th ,, 5 P.M.	18·7	18·6
,, 12th ,, 6 P.M.	18·7	18·4

The amount of soap destroyed by the use of various waters for washing purposes is seen from the following table, in which certain Welsh and Cumberland waters are also introduced for the purpose of comparison:—

Soap destroyed by 100,000 lbs. of various Waters.

	lbs. of Soap destroyed.
METROPOLITAN WATERS.	
Thames Water	212
River Lea	204
Kent Company's Water	265
OTHER WATERS.	
South Essex Company's Water	253
Caterham Company's Water	84
Water supply of Worthing	285
,, ,, Leicester	161
,, ,, Manchester	32
,, ,, Preston	80
,, ,, Glasgow (Loch Katrine)	4
,, ,, Lancaster	1
Bala Lake	5
Thirlmere	8
Haweswater	16
Ullswater	23

In the recent supply of water to Paris from new sources, the importance of soft water attracted the attention of the eminent engineer M. Belgrand; a close investigation of the available sources, however, soon showed that he had unfortunately but little choice, as the really soft streams of the Fontainebleau sands (the minimum hardness is however 6°) and of the granite of Morvan (minimum hardness 2·2°) were mere dribblets. Of the latter M. Belgrand says:—"Sources qui donnent les eaux les plus pures du bassin de la Seine; déviation vers Paris impossible, en raison du peu d'importance des sources." Hence the river Vanne (17°-20°), somewhat softer than the Thames, was the softest available source, and having first conclusively demonstrated this, he consoles the Parisians by saying—"Les eaux du granite, du greensand et des sables de Fontainebleau, qui sont chimiquement plus pures, sont beaucoup moins agréables à boire."

The second category of inorganic substances contained amongst the solid impurities of waters, consists of *the mineral compounds constituting chiefly the skeleton of decomposed sewage or manure.* The putrescible nitrogenous organic matters present in water, or in the soil through which water percolates, undergo gradual oxidation and decomposition, by which their carbon and hydrogen are converted into carbonic acid and water, and their nitrogen into ammonia, nitrous and nitric acids. The last three remain in the water, constituting a record of previous contamination with putrescible nitrogenous organic matter. But rain-water always contains ammonia, and, as Dr. Bence Jones has shown, also nitrous and nitric acids. The nitrogen in these forms in rain-water, as it finds its way into rivers and springs, amounts in the aggregate to ·032 part in 100,000 parts of water, therefore this amount must be deducted from that found on analysis, as nitrogen derived from aërial sources. The remainder, if any, represents the nitrogen derived from putrefied nitrogenous organic matters with which the water has been in contact. To express this in terms of some known standard, I employ average filtered London sewage, which contains 10 parts of nitrogen in the form of putrescible organic matter in 100,000 parts. Thus, a water which contained one part of nitrogen in 100,000, as nitrous acid, nitric acid and ammonia would contain in 100,000 parts, the nitrogenous remains or skeleton of an amount of putrescible organic matter equal to that contained in 10,000 parts of average filtered London sewage. Such a water therefore is said to have a previous sewage contamination of 10,000 parts in every 100,000 parts. But it may be asked, Is this a true record of the previous history of the water in this respect? I believe it to be so, as far as it goes. *I believe that this nitrogen as truly represents a quantity of previously existing putrescible organic nitrogenous matter, as that the bones of a megatherium demonstrate the previous existence of an individual of that species;* but as the geological record of previously existing organisms is imperfect, so is the nitrogenous record; just as chemical and mechanical agencies have broken up and dissipated the remains of millions of animals during long geological periods, so does the action of growing plants, and perhaps also of living animals, remove from water, in a few hours or days, some portion of this skeleton of previous putrescible organic matter. Thus by storage in large reservoirs, the East London Company reduced the previous sewage contamination of the river Lea last summer from about 2,000 down to 230 parts in 100,000. The previous sewage contamination of a water as determined by analysis is therefore a minimum quantity.

But in addition to the aërial, for which due allowance is made, can there not be some other source of this skeleton than putrefied sewage or manure matter? Can it not be derived from putrefied vegetable matter—from peaty matter for instance? Without utterly denying the possibility of this, I venture to assert that nowhere, in this country at least, nor probably on the continent of Europe, is there such a quantity of nitrates, nitrites, or ammonia produced from vegetable sources as to appreciably affect the truth of my proposition that the nitrogen in these forms obtained by waters from terrestrial sources is substantially due to the putrefaction and oxidation of sewage and manure matters.

It has been objected to this view of the origin and significance of these forms of combined nitrogen, that waters derived from comparatively deep wells, in the chalk for instance, contain them in large quantities; thus the Kent Company's water exhibits a previous sewage or manure contamination of from 3,000 to 5,000 parts in 100,000. It is difficult to understand how such an objection could have originated, and it certainly disappears on examination; for instance in the above case, it is well fire, while the taper is extinguished, and again relighted at the mouth of the jar. Under these conditions the combustion is incomplete, and sulphur is deposited. A cold and dry beaker-glass held over a jet of the burning gas, shows no trace of moisture. With 1½ vols. of oxygen it forms an explosive mixture. Potassic hydrate absorbs the gas completely, though more slowly than $C\Theta_2$. Dilute acids evolve H_2S and $C\Theta_2$ from this solution, so that the absorption appears to take place thus:

$$COS + (HKO)_4 = K_2C\Theta_3 + K_2S + (H_2\Theta)_2.$$

The potash solution gives a copious black precipitate with ammonio-argentic nitrate; no trace of cyanogen was found in the filtrate.

Neither chlorine nor fuming nitric acid has any action upon the gas at ordinary temperatures. Passed over heated mercury in a bulb-tube, no change is observed, though if long boiled in the gas a trace of mercuric sulphide is formed. When sodium is treated in the same way, a white crust is produced at the common temperature, which by heating easily melts and becomes darker. At a low red heat the sodium ignites, burning with a brilliant light and leaving a black easily fusible mass, containing no trace of sodic cyanide, thus proving the absence of nitrogen in the gas.

When passed through mercuric-ethyl, at near its boiling point, a violent action takes place, pure metallic mercury without a trace of sulphide is separated, and a yellow liquid is produced, having a strong garlic odour. The author supposes it to be ethylic sulphopropionate.

If heated to low redness the gas is decomposed. This fact may be used to determine its composition as follows:—

Near the closed end of a U-tube, a fine platinum wire is fused, stretching across the tube. This arm being filled with the gas over mercury, and its volume ascertained, the wire is maintained at a bright red heat by means of the battery. About the wire the gas is decomposed; thick heavy clouds of yellow sulphur-vapour fall down the tube till the decomposition is complete. After cooling, the residual gas possesses the original volume. It is odourless, does not render baryta-water turbid, and burns with a pale blue flame; the product of the combustion renders baryta-water at once milky. It is hence carbonous oxide.

	Milligrams.
Since, therefore, 1 vol. (22·33 c.c.) carbonylic sulphide weighs	60
and 1 vol. (22·33 c. c.) carbonous oxide weighs ..	28
The weight of the sulphur in the gas is	32

The gas contains therefore one atom of C, one of O, and one of S, and its formula is COS.

Two determinations of its density were made by Bunsen's method. The first, however, was on a portion of the gas before the use of the tube containing caoutchouc; it retains therefore a trace of CS_2 vapour. The observed density is 2·1152 and 2·1046 in the two experiments; the calculated is 2·0833. 60 is therefore its molecular weight. These results were confirmed by direct analyses of the gas, made according to Bunsen's methods.

In the opinion of the author, this gas is widely distributed in nature. Because it is so easily decomposed by water into $C\Theta_2$ and H_2S, however, it has generally been confounded with these substances. From some experiments of his own, Than thinks he can assert almost positively that this compound is contained in the new and remarkable thermal spring of Harkány; and also in the cold sulphur spring of Parád, both in Hungary. He sustains this view by the fact that the water freshly drawn has precisely the odour of the gas, which recalls, but cannot at all be mistaken for that of H_2S; though on standing a few hours, the sulphydric acid odour appears. For these reasons it is probable that it occurs in many other sulphur springs, and it can scarcely be doubted that it could be found among the sulphur gases of volcanic action, and perhaps in those arising from organic decomposition.

It is recognised by the following reactions: 1st. Potassic hydrate deprives the gas, or its watery solution, at once, of its peculiar odour. The alkaline solution effervesces with dilute sulphuric acid, evolving H_2S (distinction from C_2S). 2nd. In acid solutions of silver or cadmium it produces no precipitate; but upon the addition of ammonia, the respective sulphides appear (distinction from H_2S). 3rd. Sodic nitroferricyanide has no action in neutral or acid solutions; but an intense blue-violet colour is developed by potash or ammonia. 4th. Iodide of starch is decolourised in a short time by this gas.—*Ann. Ch. Pharm., Suppl.*, Band v., 236, *Oct.*, 1867.

ON THE PROPOSED WATER SUPPLY FOR THE METROPOLIS.*

By EDWARD FRANKLAND, Ph.D., F.R.S.
Professor of Chemistry, Royal Institution.

(Concluded from page 258.)

Having thus discussed the organic portion of the solid impurity of these waters, let us now turn to the inorganic or mineral portion, which may be conveniently divided, as regards its most important constituents, into three subdivisions, viz.:—

1. Soap destroying substances.
2. Mineral compounds, constituting chiefly the skeleton of decomposed sewage or manure.
3. Poisonous substances, such as arsenic, copper, and lead.

The first or soap destroying category of substances communicate to water the quality called hardness. These substances are the salts of lime and magnesia; and the quantity of them contained in the proposed, as compared with the present, metropolitan water supply will be seen on reference to the analytical table. The hardening effect of these substances is also given in a separate line of the same table, from which it will be seen that the proposed is only about 1-10th as hard as the present water supply.

Tastes differ as regards hard or soft water for drinking purposes, and medical arguments have from time to time been advanced, now in favour of and now against each. It has been asserted in this country, for instance, that hard water is necessary for the formation of bone, and that the finger of Providence points to the advantage of hard water by the profusion of calcareous strata occurring in the earth's crust, whilst M. Belgrand states that the inhabitants of the hard-water districts of France notoriously suffer from carious teeth. It would probably be extremely difficult to prove either of these assertions. As regards the enormous advantages of soft water for washing, cleansing, and manufacturing purposes, there is, however, no difference of opinion. In Glasgow alone the annual saving of soap only, by the introduction of Loch Katrine water, for a previous supply of very moderately hard water, has been estimated at 36,000*l*. Having had the opportunity of comparing a six years' experience of the soft water supplied to Manchester, with a subsequent ten years' experience of the hard water of London, I can state that the soft water was for all purposes preferred by every member of my family. On removing from Manchester to London, the repugnance to drink the hard water of the latter city was at least as marked as that which I have sometimes noticed in persons making the transition in the opposite direction.

The hardness of the London waters is chiefly what is termed *temporary* hardness; that is, it is caused by the

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* Read before the Royal Institution of Great Britain, Friday, April 3, 1868.

Previous Sewage, or Manure Contamination, in 100,000 parts, of various Spring-waters.

Name of Waters.	Ammonia.	Nitrogen as Nitrates and Nitrites.	Previous Sewage Contamination.
Mother Ludlaw's Cave	·001	·034	30
Water supplied to Ferette (Haut Rhin)	—	·039	70
Spring near Dürmenach (Haut Rhin)	—	·114	820
Source of the Roppensviller (Haut Rhin)	—	·168	1360
Source of the Arcueil	—	1·111	10790
" " But at Montmartre	—	8·563	85310
" " Martinet	—	·557	5250
" " Trois Meules, St. Etienne	—	·210	1780
Spring at Nimes	—	·129	970
Ebersbronn (Bas Rhin)	—	·447	4150
Water supplied to Woerth-sur-Sauer (Bas Rhin)	—	·259	2270
Source of the Ill, near Winckel (Haut Rhin)	—	·104	720
Liebfrauenberg Spring (Bas Rhin)	—	·005	0
Seltz (Bas Rhin)	—	·008	0
Mineral Spring of Bussang (Vosges)	—	·003	0
Water supplied to Thann (Haut Rhin)	—	·010	0
Source of the Boelaeker (Haut Rhin)	—	·018	0
Spring at Castle Fleckenstein (Bas Rhin)	—	Traces.	0
Thermal Spring at Baden	—	·016	0
" " Dax	—	·013	0
Source of the Presle (East Pyrenees)	—	·013	0

The results embodied in the above tables throw considerable additional light upon this form of water contamination. They show in the first place that waters which have not been in suspicious company exhibit little if any previous sewage contamination, thus in the whole of the Cumberland and Westmoreland district it only occurs in one instance (the Upper Kent which, as every tourist knows, has a little cultivated land on its banks), and that to a small extent only. In the Welsh waters again there are only three instances. The spring-water, which issues from the Greensand beneath an uncultivated but heather-covered surface at Mother Ludlaw's Cave, near Farnham, exhibits a mere trace of this contamination, whilst the waters of nine springs on the Rhine, in the Vosges, and in the Pyrenees, examined by M. Boussingault, exhibit no indications of previous sewage contamination. On the other hand, the spring forming the source of the But and issuing not far from the cemetery at Montmartre at once discloses its antecedents, and exhibits a previous sewage contamination of 85,310 parts in 100,000. It will be seen that the water of the Ourcq, which is now used only for watering the streets of Paris, exhibits a previous sewage contamination somewhat less than Thames water.

But what is the import of this previous sewage contamination? These skeleton compounds are innocuous, why trouble ourselves about them? True, they are innocuous, or nearly so; but inasmuch as they show that the water has been in contact with animal refuse they bring a heavy charge of suspicion against it. These refuse animal matters are known to contain that which is hurtful to human life. This hurtful matter is believed, on very strong evidence, to consist of spores, or germs of organisms, which are capable, under favourable circumstances, of producing in man such diseases as cholera, typhoid fever, and dysentery. Now such spores or germs, endowed as they are with vitality, will be likely to resist the oxidising agencies which convert the rest of the animal refuse into carbonic acid, water, nitric acid, nitrous acid, and ammonia. For instance, if the contents of an egg were beaten up with water and poured into the Thames at Oxford, the organic matter would probably be entirely oxidised and converted into mineral compounds before it reached Teddington; but if the egg were thrown whole into the Thames at Oxford, it would, if it retained its vitality, be carried down to Teddington without any decomposition of its organic matter. There can be no doubt that the spores or germs of many organisms are in like manner capable of resisting for a long time the decomposing action of water. Now no practicable process is known by which these spores, once introduced into water, can be again removed or can have their vitality destroyed. Filtration will not do it; in fact it is well known to engineers that water is often contaminated with visible suspended matter which cannot be separated by filtration; thus M. Belgrand says, "Lorseque l'eau est troublée dans le fleuve, elle sort louche de nos filtres." And again, speaking specially of the London water supply, "Le mode de dégrossissage employé par les grandes compagnies anglaises, *très convenable à Londres, ou l'on ne boit pas d'eau, ne vaut rien à Paris, ou les femmes, les enfants, les vieillards de la classe ouvrière n'ont pas d'autre boisson*. J'ai constaté par moi même, et les ingénieurs anglais n'en disconviennent pas, que l'eau sort des filtres *très chargée de matiere organique*." Again, in the account of his highly remarkable researches on vaccine and small-pox poisons, recently communicated to the Academy of Sciences, M. Chauveau says regarding the organic germs contained in these poisons, that they "ne se déposent jamais complètement dans les couches profundes du milieu ambient, et passent à travers tous les filtres."

Boiling even for several hours cannot be relied upon for the destruction of such germs, some of which have recently been shown to retain their vitality after four hours boiling; in fact there can now no longer be any doubt that as contended by M. Pasteur, the cases of so-called spontaneous generation have all had their origin in ignorance of the excessive tenacity of life in the germs of the lowest organisms.

Nothing short of distillation therefore, as it is carried on in nature, can be relied upon to free, completely, sewage-contaminated water from its noxious constituents. Excessive filtration is doubtless to some extent a safeguard, and hence previous sewage contamination in chalk-water, if we could be certain that the water had been fairly filtered through some 100 feet of chalk, and that none of it gained access to the wells through fissures or swallow-holes, would have far less significance than it has in the case of a river water where the fine-suspended and noxious matters of sewage have but a comparatively slender chance of removal before the water reaches the consumer. We must also not forget that mere dilution fails, in the case of these suspended germs, to destroy their noxious quality, differing as they do in this respect remarkably from soluble poisons. The daily casting of a thousand fatal doses of strychnine into the Thames at Oxford ought not to occasion so much alarm amongst the London water-drinkers as the present flow of the Oxford sewage into the river, because the excessive dilution of the soluble strychnine would effectually prevent its producing any physiological effect. Each noxious living germ, on the other hand, contains within itself the power of indefinite multiplication and mischief. One such germ may be present in a wineglass-full of water, whereas it would be necessary to drink many thousand gallons of water to imbibe a noxious amount of strychnine, under the conditions just alluded to. I am therefore of opinion that water once contaminated with sewage or manure matter ought never again to be used for domestic purposes, if any other supply can be obtained; and I endorse the advice of M. Belgrand and the principle which guided him in the selection of the new water supply for Paris:—"On a dit des eaux potables, qu'elles étaient comme la femme de César, qu'elles ne devaient pas meme être soupçonnées, et c'est mon avis."

A few words will now suffice regarding the third class of mineral matters that may be present in the solid impurities of waters, viz., *poisonous substances, such as arsenic, copper, and lead.* These substances are only likely to occur in waters connected with mineral workings—one of them only, lead, has been detected in the proposed supplies, and that only in two streams in Cumberland, and in quantity far two minute to require any further notice.

The following table exhibits a comparative view of the amount and quality of the gases contained in the proposed and present supplies:

Gases expelled on boiling 100 *volumes of various Waters.*

Names of Gases.	Welsh Waters. Mean.	Cumberland Waters. Mean.	Thames Water. Mean.	Distilled Water.
Nitrogen	1·323	1·424	1·656	1·133
Oxygen	·612	·726	0·801	·617
Carbonic acid	·227	·281	3·652	·105
	2·162	2·431	6·109	1·855

You will find that the gases contained in the Welsh and Cumberland waters are very similar in quantity and proportion to those found in recently distilled water. Collected as these waters are near the mountain ranges which constitute the great condensers of natural distillation, this is exactly the result we should expect. The London waters differ mainly in containing more carbonic acid in solution, which makes them more sparkling in appearance. Sparkling waters are generally preferred by the public, although they commonly owe their briskness to extensive contact with decaying organic matter. It is thus that the highly-sparkling pump-waters of London are still preferred by many. On the other hand, soft waters are not necessarily vapid; no draught of water could be more delicious than that which is obtained from the public drinking-fountains of Glasgow, supplied from Loch Katrine, although I find that 100 volumes of this water contain only the following gaseous constituents:—

Nitrogen	1·731	vols.
Oxygen	·704	„
Carbonic Acid	·113	„
	2·548	

Action upon Lead.

The conditions which determine the action or non-action of water upon lead, have hitherto been involved in much obscurity. Messrs. Graham, Miller, and Hofmann, the Government Commission of 1851, on the supply of water to the metropolis, established the fact that the presence of dissolved oxygen and the absence of more than three volumes of carbonic acid in 100 volumes of water, are amongst the conditions necessary for the attack of lead.

The whole of the present water supply of the metropolis is perfectly protected from acting upon lead by the large quantity of carbonic acid which it contains. Still there are obviously other conditions involved in the problem; for all the samples of water from the Welsh and Cumberland districts contain, as shown in the above analytical results, dissolved oxygen, whilst not one of them possesses an amount of carbonic acid even remotely approaching that which is necessary to protect it, and yet some of these waters act violently upon lead, whilst others are entirely without action upon the metal. Having recently had occasion to observe that a sample of distilled water, which acted powerfully upon lead, completely lost this quality by momentary contact with animal charcoal, I found on further investigation, that a minute quantity of the chief constituent of bone-black, viz., phosphate of lime, completely protects water from action upon lead. I then carefully examined for phosphate of lime, the water of the River Kent (Upper Kent) which is eminently distinguished for its violent action upon lead, and the water of the River Vyrnwy, which, although nearly as soft as distilled water, has not the slightest action upon lead, even when placed in contact with a bright and freshly-cut surface of the metal for 24 hours. This examination established the fact that the water of the Vyrnwy contained an appreciable amount of phosphate of lime, whilst not the slightest trace of this substance could be detected in that of the Upper Kent. The waters from both the proposed districts have been carefully examined as regards their behaviour towards lead, and, as the result of this examination, it may be safely affirmed that no danger on this score need be apprehended from the introduction of water from either districts into the metropolis. I here exhibit to you samples of lead in various waters exemplifying the points upon which I have just spoken.

Lastly, I place before you in these large cylinders, holding more than a gallon each, samples of the Welsh and Cumberland waters, side by side with a similar sample of Thames water, which fairly represents the condition of more than 3-5ths of this water as it has been delivered in London since 21st of January last. But it may be asked, will these waters from Wales or Cumberland reach the metropolis in this colourless, transparent, and soft condition after passing through a conduit from 180 to 280 miles in length? Let me tell you what I conceive will be the effect of such a conduit upon the water. For the first two or three years a certain amount of lime from the surface of the cement in the conduit will dissolve in the water, communicating at first an amount of hardness probably not exceeding 5°; this effect will gradually subside, and after two or three years the water will be delivered in London in a slightly better condition than that in which it leaves the storage reservoirs—a slightly better condition because it will be somewhat better aërated than when it starts on its journey. At the present moment the water of Loch Katrine passes through a conduit 26 miles long, and I have lately carefully taken its hardness as it leaves the lake and as it is delivered to consumers in Glasgow. Its hardness on delivery in Glasgow is only 0·3°, exactly the same as in the lake, and its transit through 26 miles of conduit has therefore added no hardening constituent to the water. Now, if 26 miles of conduit fail to alter the hardness, I can only conclude that 180 or even 280 miles of conduit, if properly constructed, will also, after the lapse of a few years, be equally incompetent to produce any substantial increase in the hardness. At the time the above experiments were made, Loch Katrine water had flowed through the conduit for seven years.

These are the principal points I have to bring before you in connection with the proposed supply, and as a summary of the chemical investigation of the present water supply on the one hand, and of the samples furnished by the Welsh and Cumberland districts on the other, I may state the following conclusions to which these investigations have led me:—

1. The present water supply of the metropolis is largely contaminated with sewage. Both analysis and statistics concur in the statement that each glass of Thames water taken from the river by the companies, contains one teaspoonful of sewage.

2. Although this sewage is generally to a great extent oxidised before the delivery of the water in London, yet there is no guarantee whatsoever that all its noxious qualities are removed, because these noxious qualities are, in all probability, contained in the mechanically suspended and least oxidisable portion of the sewage.

3. The river water supplied in London is often very imperfectly filtered; and thus even the visible suspended matters of sewage are not wholly excluded from the water supply. Only on one occasion during the whole year 1867, have I obtained a transparent sample of water from the Southwark Company's mains. The Grand Junction Company's water was turbid four times out of twelve, the Chelsea thrice, the West Middlesex, Lambeth, and East London each twice, out of the twelve occasions when the samples were drawn for analysis. The New River Company alone delivered perfectly filtered water during the whole year.

4. The quality of the water supplied to London is greatly inferior to that of any other town in the United Kingdom, whose supply I have examined.

5. The distribution of water in the metropolis still continues, with but slight exceptions, on the intermittent

system, a system which has been abolished in almost every town of importance in the United Kingdom.

6. The water which it is proposed to supply either from the Welsh or the Cumberland districts is of excellent quality. It is equal or superior to that supplied to any town in Great Britain.

7. The water from each of the proposed districts is extremely soft, pleasant to drink, and of good aëration.

8. These waters have never been contaminated with sewage, and are therefore above all suspicion.

9. They can be distributed in the present system of supply pipes without any danger of lead contamination.

The choice between the present and proposed supply rests virtually with the intelligent inhabitants of the metropolis. Will you go to a source of pure water uncontaminated with sewage, or will you continue the existing supply? I can anticipate your verdict, but you must not delay to record it. These splendid sources now available will not remain much longer within your reach.

In conclusion, I beg to quote the opinion of one of our highest medical authorities on the dangers of sewage-contaminated water. Unpleasant as the theme may be, this opinion is in the highest degree deserving the earnest attention of every individual who has progressed beyond the state of savagery. In his Report on the Cholera Visitation of 1866, Mr. Simon, the medical officer of the Privy Council, says:—"It cannot be too distinctly understood that the person who contracts cholera in this country is *ipso facto* demonstrated with almost absolute certainty to have been exposed to excremental pollution; that what gave him cholera was (mediately or immediately) cholera-contagium discharged from another's bowels; that, in short, the diffusion of cholera among us depends entirely upon the numberless filthy facilities which are let exist, and especially in our larger towns, for the fouling of earth and air and water, and thus secondarily for the infection of man, with whatever contagium may be contained in the miscellaneous out-flowings of the population. Excrement-sodden earth, excrement-reeking air, excrement-tainted water, these are for us the causes of cholera. That they respectively act only in so far as the excrement is cholera-excrement, and that cholera-excrement again only acts in so far as it contains certain microscopical fungi, may be the truest of all true propositions; but whatever be their abstract truth, their separate application is impossible. Nowhere out of Laputa could there be serious thought of differentiating excremental performances into groups of diarrhœal and healthy, or of using the highest powers of the microscope to identify the cylindro-taenium for extermination. It is excrement, indiscriminately, which must be kept from fouling us with its decay.

"And thus it is that my practical advice remains substantially what it has been for years. The local conditions of safety are, above all, these two:—(1) that, by appropriate structural works, all the excremental produce of the population shall be so promptly and so thoroughly removed, that the inhabited place, in its air and soil, shall be absolutely without fœcal impurities; and (2) that the water supply of the population shall be derived from such sources, and conveyed in such channels, that its contamination by excrement is impossible.

"What good results are got even by rough approximation to those sanitary standards has already been abundantly shown here. The way in which the southern districts of London, with their three-fourths of a million of population, have gradually gained *comparative* immunity from cholera *in proportion* as their two water companies have ceased to distribute sewage-tainted water among them, is a matter of familiar history.

"That cholera is still a terror to Europe shows how scantily such illustrations are yet understood. Even here in England the objects which I have named as essential are at best but rarely fulfilled; indeed for vast numbers of our population scarcely rudimentary endeavours have been made to attain them. Town after town might be named, with myriad on myriad of population, where there is little more structural arrangement for the removal of refuse than if the inhabitants were but tented there for a night. The case of the water supply is no better: my reports are incessantly showing the too frequent foulness of private supplies, while as regards public water supplies, *such as generally are in the hands of commercial companies*, it has again and again been shown (and seldom more pointedly than in the present volume), that their conveniences and advantages are countervailed by dangers to life on a scale of gigantic magnitude, unless those who administer the supplies act under a very deep sense of responsibility.

"Cholera, ravaging here at long intervals, is not Nature's only retribution for our neglect in such matters as are in question. Typhoid fever and much endemic diarrhœa are, as I have often reported, incessant witnesses to the same deleterious influence; typhoid fever which annually kills some 15,000 to 20,000 of our population, and diarrhœa which kills many thousands besides. The mere quantity of this wasted life is something horrible to contemplate, and the mode in which the waste is caused is surely nothing less than shameful. It is to be hoped that, as the education of the country advances, this sort of thing will come to an end; that so much preventible death will not always be accepted as a fate; that for a population to be thus poisoned by its own excrement, will some day be deemed ignominious and intolerable."

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, April 24, 1868.

ON SOME NEW EXPERIMENTS ON LIGHT.

By J. H. GLADSTONE, Ph.D., F.R.S.

The speaker commenced by referring to the fact that we are constantly making new experiments or observations on light: in fact, all seeing is but a comparison of different degrees of light and shade, and the contrast of colours. Most of the rays that meet our eyes from surrounding objects are reflected rays, but some of the commonest things, such as the water-bottles and tumblers of cut-glass on our dining tables, exhibit beautifully the bending, the magnifying, the diminishing, and the production of coloured fringes, due to refraction. The purpose of this discourse was to rise from the simplest phenomena of this kind to a consideration of refraction-equivalents, and to describe the state of our present knowledge in regard to them.

By means of the electric lamp it was shown that a piece of glass, or other transparent body, will throw a perfectly black shadow if the two surfaces through which the ray passes be not parallel; that the light is then bent on one side, and at the same time spread out into its component colours; that this bending (refraction) varies with the amount of inclination of the two surfaces to one another, but in such a way that the sine of the angle of refraction bears a constant ratio to the sine of the angle of incidence; that this constant number, termed the index of refraction, or μ, belongs only to the one substance, each solid liquid, or gas, having its own index; that there is no necessary connection between the amount of refraction and the length of the spectrum (dispersion) caused by different substances, whether gaseous, liquid, or solid—for instance, a solution of an iodide always disperses more than a solution of the chloride of the same metal, even though it be diluted to the same amount of refraction.

This index of refraction is affected by change of temperature. In liquids, and probably in all gases, the bending decreases as the thermometer rises; in solids, on the contrary, as lately shown by Fizeau, the change is in the opposite direction, crown glass always remaining the same, and fluor spar being the only case where he observed a diminution. This was experimentally demonstrated in regard to liquids. Thus a yellow sodium ray, which had passed through a hollow prism filled with oil of nutmeg, and thence through another filled with bisulphide of carbon, moved some inches along the screen, when the nutmeg oil was warmed a few degrees by stirring it with heated iron wire. This index of refraction is still more materially affected when a body passes from the solid to the liquid, or from the liquid to the gaseous condition; a fact that was illustrated by the visibility of the water melted in crystalline spaces in the middle of a block of ice.

The index of refraction of a mixture is moreover not always the mean of the indices of its constituents. Thus a ray passed successively through two hollow prisms filled with equal quantities of alcohol and water respectively, fell on the screen in a certain position; but when the two liquids were mixed together, and divided between the two prisms, the ray was visibly refracted to a greater distance.

These changes depend on the alterations of volume which the substances undergo; and the speaker, in conjunction with the Rev. T. Pelham Dale, had observed in liquids that the index of refraction, *minus* unity, divided by the density (in symbolic language $\frac{\mu-1}{d}$) is constant for all temperatures, and for all mixtures, or rather that the coincidence is very close but not quite perfect on account of some other law not yet understood. This conclusion has been abundantly verified by Landolt of Bonn, Ketteler, and Wullner, and the former experimenter has founded upon it a method of analysing mixtures of liquids.

This unchangeable number was termed the "specific refractive energy" of the substance, and it seemed to hold good notwithstanding a change from the solid to the liquid or the gaseous condition. It was early observed that the specific refractive energy of a compound bore a close resemblance to the mean of the specific refractive energies of its components. Landolt, by multiplying this number by the chemical equivalent, facilitated the calculation greatly. He termed this new number the "refraction-equivalent," $P\frac{\mu-1}{d}$, and proofs have rapidly accumulated that the number is little affected, not only by temperature, change of aggregate condition, mixture, or solution, but even by strong chemical combination.

Thus diamond, which is crystallised carbon, has the refraction-equivalent 5·0; sulphur has 16·0. Bisulphide of carbon, CS_2, which is nearly the most refractive liquid known, should therefore be represented by $5 + 2 \times 16$, that is 37·0. The experimental number is 37·3. But the diamond will burn in oxygen, and is thus converted into carbonic anhydride, while it is possible to reduce this gas into another containing only half the amount of oxygen, namely, carbonic oxide. The refraction-equivalents of these gases, as deduced from Dulong's observations, are respectively 10·03 and 7·53; but the difference between CO_2 and CO is one equivalent of oxygen, and the difference between the above numbers is 2·5. This then may be taken as the refraction-equivalent of oxygen, and subtracting it from CO = 7·53 we have remaining C = 5·03, practically the same number as that obtained directly from crystallised carbon. Similarly, but generally by more indirect methods, it has been determined that this element, whether pure as diamond or combined with other elements to form gases as the above-mentioned, coal-gas, or cyanogen, or liquids as chloride of carbon, benzol, oil of turpentine, alcohol, or ether, or solids as paraffin, sugar, or camphor, is still exerting the same influence on the rays of light that set its particles in motion, an influence that we can express by the number 5·0. Again, to revert to sulphur, the two salts sulpho-cyanide and cyanide of potassium—K S Cy and K Cy—differ by one equivalent of this element, and their refraction-equivalents as determined from their aqueous solutions are respectively 33·4 and 17·1, numbers differing by 16·3, a number almost identical with that reckoned from molten sulphur. In this way the refraction-equivalents of a large number of the elements have been determined; and the following table comprises what seem the most probable numbers among those that have been hitherto published by Landolt, Haagen, and Schrauf, as well as the speaker:—

	Atomic-weight.	Refraction-equivalent.
Hydrogen	1·0	1·3
Chlorine	35·5	9·8
Bromine	80·0	15·7
Iodine	127·0	24·4
Oxygen	16·0	3·0
Sulphur	32·0	16·0
Carbon	12·0	5·0
Silicium	28·0	6·2
Nitrogen	14·0	4·1
Phosphorus	31·0	18·5
Arsenic	75·0	16·0
Antimony	122·0	25·7
Vanadium	51·4	25·4
Sodium	23·0	4·9
Tin	118·0	19·2
Copper	63·4	11·2
Mercury	200·0	21·6

The above numbers are reckoned for the red ray. Most of them as yet claim to be considered only as approximative; and it seems certain that some elements, as oxygen and sulphur, have more than one refraction-equivalent.

Vanadium, though included in the above table, has only just been determined, and that from the oxytrichloride which Professor Roscoe exhibited a few weeks before. It is interesting, as it supports his theory of the close analogy of phosphorus and vanadium, for these two bodies, with sulphur, exceed all others in refraction and especially in dispersion.

The speaker stated that he was now engaged in examining the effect of salts in solution on the rays of light, and that he hoped to determine in this way the refraction-equivalents not only of a multitude of salts, but of the metallic elements themselves.

But the question may be asked, "If a substance has a refraction compounded of the refraction of its constituents, how can bodies such as Iceland spar have two refractive indices?" Now these are crystalline bodies, or if uncrystallised they have become doubly refracting by being unequally heated or compressed. In either case we may suppose a different amount of tension in different directions; and the fact of the two rays being oppositely polarised points to some such difference of molecular arrangement. It is easy to understand that the change of tension or internal structure may act in the same way as a change of density in modifying the velocity of transmitted light, and therefore the amount of its refraction. But if we take the crystal to pieces by dissolving it, there can then no longer be unequal tension or unsymmetrical arrangement of particles, and it must have one refraction-equivalent. And this is always the case. The numbers deduced from Brewster's observations of the two rays of crystallised nitre are 16·3 and 25·0, while the equivalent of nitre dissolved in water is the intermediate number 21·8.

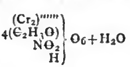
FOREIGN SCIENCE.

PARIS, JUNE 3, 1868.

A plea for unapplied science.—The congress at Sorbonne.—New acetate of chromium.——ACADEMY OF SCIENCES:—Manufacture of phosphate and fluoride of sodium.—New process of refining sugar.—Vegetable fibres employed in industry.—18th of May: Award of the long-deferred prizes.

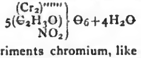
AT a Congress of the Learned Societies, at Sorbonne, M. Nicklès delivered a lecture "On the new fluosalts and their uses." An account of the ferric fluosalts made by M. Nicklès has already appeared under the heading Foreign Science. He showed the disappearance of colour from the sulphocyanide of iron upon the addition of an alkaline fluoride, and numerous experiments of a similar kind, showing how the ordinary coloured precipitates of various metallic oxides were modified. Fluoride of potassium offers no impediment to the production of ferrocyanide of copper, but many polycyanides are decomposed. Platino-cyanide of magnesium is precipitated white, at the same time that it loses its dichroism; the beautiful blue crystals of mangano-cyanide of potassium are also destroyed by fluoride of potassium. After describing numerous coloured substances that were interfered with, M. Nicklès remarked—"What is the good of all these operations, having for their purpose the destruction of beautiful colours, will one ask? New facts are made known, errors are rectified, the history of a simple body becomes complete, but what matters this to those who cry *cui bono* where these products of human labour, where these conquests over nature are not immediately applicable to our physical wants. We might reply, that a new fact being acquired, no one can predict all the consequences which may result." M. Nicklès justified in eloquent terms purely scientific research, and alluded to the vast number of substances, largely employed in industrial operations, which had remained unused for great lengths of time, in the majority of cases, too, these substances having been first made only for scientific interest.

A paper "On a new acetate of chromium," has been published by M. Schützenberger. By mixing four or five equivalents of neutral acetate with one equivalent of neutral nitrate, and concentrating by heat, small green crystals were obtained; this salt, dried at 110°, possessed the formula—



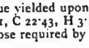
$$\left.\begin{matrix}(\mathrm{Cr_2})'''''' \\ 4(\text{Ȼ}_2\mathrm{H_3O}) \\ \mathrm{N\Theta_2} \\ \mathrm{H}\end{matrix}\right\}\Theta_6+\mathrm{H_2O}$$

The salt is soluble in warm glacial acetic acid, the solution upon cooling yielding beautiful fern-like masses of crystals, which, after desiccation, possess the formula—



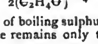
$$\left.\begin{matrix}(\mathrm{Cr_2})'''''' \\ 5(\text{Ȼ}_2\mathrm{H_3O}) \\ \mathrm{NO_2}\end{matrix}\right\}\Theta_6+4\mathrm{H_2O}$$

From these experiments chromium, like iron, is evidently capable of forming a series of salts of two acids. Interesting as this may be, M. Schutzenberger has investigated the action of heat upon various acetonitrates, and the account of their behaviour when heated occupies the larger portion of the paper referred to. The final result and progressive states, induced by heat, are the same in all of these salts. Towards 200° water and acetic acid are disengaged; above this temperature nitrous vapours appear, at the same time the pulverulent residue assumes a deep yellowish brown tint. At this stage the compound is still soluble in water, and reagents detect the presence of chromic acid. Finally, at about 350° (in mercurial vapour) a brisk action is established, gas being disengaged, and the light powder thereby thrown into little conical heaps. In a few moments this stage is passed, and there remains a light powder of a clear green tint, pyrophoric while hot. The ultimate product contains no nitrogen; prepared with an acetonitrate purified several times by crystallisation, and heated by mercurial vapour in a current of carbonic acid to remove acid vapours and protect the heated residue from the atmosphere, the residue yielded upon analysis the following numbers:—Cr 34·1, Ȼ 22·43, H 3·14, numbers agreeing pretty closely with those required by the formula—



$$\left.\begin{matrix}(\mathrm{Cr_2})'''''' \\ 3(\text{Ȼ}_2\mathrm{H_3\Theta}) \\ \mathrm{H}\end{matrix}\right\}\Theta_5$$

which is that of a first, triacetochromic anhydride. In presence of water this powder hydrates immediately, with elevation of temperature, and becomes a homogeneous green paste. Dried, this paste shows a fine deep and peculiar green tint, possessing transparency. As more and more water is added, the paste becomes proportionately thinner, till at last a veritable solution is apparently produced. This solution is colloidal: the addition of a neutral salt of an alkali precipitates the whole of the acetate. The anhydrous powder, heated to about 400°, loses more acetic acid, while retaining the property of hydrating with water; probably there is formed a second anhydride, diacetochromic anhydride—



$$\left.\begin{matrix}(\mathrm{Cr_2})'''''' \\ 2(\text{Ȼ}_2\mathrm{H_4\Theta})\end{matrix}\right\}\Theta_4.$$

Finally, in the vapour of boiling sulphur the decomposition is complete, and there remains only the anhydrous oxide mixed with carbon.

The following memoirs were brought before the Academy at the meeting held on the 11th of May:—"Analysis of a chromiferous pig iron," by M. Boussingault (translated in full); "on a new process of refining coarse sugars and molasses, yielding colourless and pure sugar, without the employment of animal black or albuminous substances," by M. Woestyn; "vegetable filaments employed in industry, characters permitting of distinguishing between them;" M. Jean addressed a rectification to his note on the manufacture of phosphate and fluoride of sodium; M. Zaliwski-Mikorski made a communication relative to the weight of the air.

The process of sugar-refining made known in M. Woetsyn's memoir is simple. The sugars being dissolved to a certain degree Beaumé, varying according to the practice of the refinery, milk of lime is introduced, the amount added for fine coloured sugars being reckoned by thousandths, progressing to hundredths for the yellow tints. After having intimately mixed the lime and the syrup, a current of carbonic acid is made to pass into the mixture, until test paper shows no trace of alkalinity. M. Woestyn operates at from 20° to 30° C. The operation is terminated by ebullition, to decompose the bicarbonates, and the deposit is separated by filtration, sometimes decantation may be substituted. The resulting sprup is deprived of colour, and yields sugar of great fineness, both in regard to taste and brilliancy.

M. Vétillard's memoir was a very minute description of the microscopical characters, when treated by reagents, and in some cases dissected, of linseed, hemp, jute, New Zealand flax, China grass, and cotton fibres.

M. Jean informed the Academy that by an error in calculation, he had come to the conclusion that in fusing tribasic phosphate of lime with an excess of sulphate of soda and carbon, nearly the whole of the phosphoric acid was obtained in the state of neutral phosphate. Recent experiments have proved to him, that under these conditions, the phosphate of lime only cedes two-thirds of the phosphoric acid in the soluble state.

At the meeting held on the 18th, M. Chevreul presided, and the prizes in various branches of sciences were awarded to the candidates of 1867. The prize subjects ranged through many sciences, physiology, medicine, astronomy, mathematics, chemistry, &c. The works worthy of a prize in connection with noxious trades (founded by M. De Montyon) were considered by MM. Combes, Dumas, Payen, Balard, and Chevreul, reporter. The report states that long since the law of 1810 has shown itself insufficient, notwithstanding various modifications made, indeed for twenty years the necessity has been felt of placing the class of manufactures referred to in this law more in harmony with the progress of science, in the double interest of health and the manufactures themselves. The law of 1810 was created especially to prevent the dangers of acid vapours such as arise in the roasting of pyrites and the hydrochloric acid of the alkali factories recently established. Doubtless at this epoch there existed many works operating upon organic matters, and the inconvenience they caused was known; but these works were then restricted in number, and confined to localities where from their long existence, the inconveniences to the neighbourhood were tolerated. It was then in the double cause of the public health and the progress of industry that the administration of agriculture, commerce, and works, directed the consulting committee of arts and manufactures to revise the law of 1810. The committee deemed it desirable that they should possess a knowledge of the state of the factories and works in the foreign countries most advanced in point of industry, and to this end, M de Freycinet, a mining engineer, was commissioned to visit England. The subject of the questions proposed to M de Freycinet were—(1). The examination of factories or works considered dangerous or inconvenient from three points of view: the pollution of the atmosphere, the pollution of water, and the influence of the process upon the workmen. (2). The indication of the means, or processes of abatement employed in each noxious manufacture. M. de Freycinet's mission resulted in a report of 118 pages.

Finally, in 1866, M. de Freycinet visited England again by authority, this time to examine the employment of the sewage water of London. The first report was deemed so valuable that M. de Freycinet was charged to make a similar work for France; this matter was embodied in a report of 247 pages. The prize commission recognising the value of his services, proposedto award to M. de Freycinet 2500 francs. The proposition received the approbation of the Academy.

The chemical section unanimously voted the Jecker prize to M. Berthelot for his late researches on the carbides of hydrogen.

LABORATORY NOTES.

PREPARATION OF LITMUS PAPER.

I have had much trouble in obtaining a thoroughly satisfactory litmus paper. When used with blotting paper it is not as delicate as could be wished, and on one occasion when attempting to make it with sized paper, the blue tincture persistently turned red when it touched the paper. The latter reaction seemed to be due to the sizing material, and it occurred to me that if I sized some paper myself with pure gelatin, my object would be obtained.

I can recommend the following receipt:—

"Digest 20 grm. litmus with 100 c.c. water for some time, shaking occasionally; then filter. To the filtrate add a slight excess of nitric acid, and boil; then neutralise exactly with potash. Now make a weak solution of gelatin by boiling 1 part of isinglass with 50 parts of water; draw white blotting paper through this and hang it up to dry. When dry paint one side with the above solution of litmus."

A. VACHER.

20, Great Marlborough Street, May 30.

MISCELLANEOUS.

Adulteration of Wines.—It is much to be regretted that cheap wines advertised and offered to the public as pure and wholesome, are adulterated with alum, and other ingredients of a most deleterious nature. Dr Barbier in the *Gazette Medicale de Lyon* states that he has treated a whole family, in vain, for acute pains in the stomach and indigestion. At last he had their wine analysed and found no less than two drachms of alum in the bottle. As soon as their wine was changed, their gastralgia ceased. We have ourselves obtained samples of so called *pure* claret, which we have reason to believe, contained a considerable quantity of alum; it is therefore evidently necessary for those who are accustomed to drink these wines, to have some guarantee of their purity.

Lighting the Street Lamps by Electricity.—The street Gas-Lighting Machines by Electricity, to be seen at No. 7 Duane street, are really wonderful, and we see no reason why they should not be generally adopted by all the cities using gas for lighting, on the points of economy and convenience. It is a simple, small machine placed in each lamp-post and connected by insulated wires with a central point, where the operator can, by simply starting the clock work attached to the batteries, at once open the cocks is each lamp and light up a whole city in the twinkle of an eye, or put out the lights at his pleasure. We notice by our Mayor's late inaugural address, that 38,000 dollars is the estimate for labour and lighting of the city street lights. The labour and the amount of gas that would be saved in the time allowed for lighting and putting out, and the amount that is now used on bright moonlight nights, constitute an aggregate and no doubt would more than pay for the whole expense of introducing the improvement for the first year. The experiments at Duane are worth witnessing by all.—*N. Y. Times.*

The Secrets of the Ocean.—Mr. Green, the famous diver, gives the following sketch of what he saw at the "Silver Banks," near Hayti:—"The banks of coral on which my divings were made are about forty miles in length, and from ten to twenty in breadth. On this bank of coral is presented to the diver one of the most beautiful and sublime scenes the eye ever beheld. The water varies from ten to one hundred feet in depth, and so clear that the diver can see from two to three hundred feet when submerged, with but little obstruction to the sight. The bottom of the ocean, in many places, is as smooth as a marble floor; in others it is studded with coral columns, from ten to one hundred feet in height, and from one to eighty feet in diameter. The tops of those more lofty support a myriad of pyramidal pendants, each forming a myriad more, giving reality to the imaginary abode of some water nymph. In other places the pendants form arch over arch; and, as the diver stands on the bottom of the ocean, and gazes through in the deep winding avenues, he finds that they fill him with as sacred an awe as if he were in some old cathedral which had long been buried beneath old ocean's wave. Here and there the coral extends to the surface of the water, as if the loftier columns were towers belonging to those stately temples that are now in ruins. There were countless varieties of diminutive trees, shrubs, and plants, in every crevice of the corals where water had deposited the earth. They were all of a faint hue, owing to the pale light they received, although of every shade, and entirely different from plants that I am familiar with that vegetate upon dry land. One in particular attracted my attention; it resembled a sea fan of immense size, variegated colours, and the most brilliant hue. The fish which inhabit these 'Silver Banks' I found as different in kind as the scenery was varied. They were of all forms, colours, and sizes—from the symmetrical goby to the globe-like sunfish, from the dullest hue to the changeable dolphin."—*Journal of the Telegraph.*

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

965. H. Bessemer, Queen Street Place, Cannon Street, London, "Improvements in the manufacture of refined iron and of malleable iron and steel."

967. H. Bessemer, Queen Street Place, Cannon Street, London, "Improvements in the manufacture of malleable iron and steel, and in apparatus used in such manufacture."—March 21, 1868.

978. G. F. Guy, Bury St. Edmunds, Suffolk, "Improvements in the manufacture of sugar and other alimentary substances from beet-root."

983. E. Vignier, Fowkea Buildings, London, "Improvements in distilling and rectifying spirits, and in apparatus employed therein."—March 23, 1868.

1020. T. Whitehouse, Wednesbury, Staffordshire, "Improvements in blast furnaces."

1023. J. Jameson, Catherine Terrace, Gateshead, Durham, "Improvements in the preparation of safety paper."—March 25, 1868.

1044. T. Routledge, Ford Works, near Sunderland, and W. H. Richardson, Jarrow-on-Tyne, "Improvements in bleaching Esparto and other fibrous substances used in paper making."—March 26, 1868.

1045. A. Warner, Laurence Pountney Lane, London, "Improvements in the manufacture of cement."

1048. A. Scott, Paddington, Middlesex, "The production of an alcoholic fermented dry, sweet, or effervescent drink, of which tea or coffee, or theine or caffeine, is an essential ingredient."

1050. F. Bauman, Wellington Street, Strand, Middlesex, "The preparation of a certain combination of chemical substances, and its novel application to the treatment of wood or other fibrous material in the preparation of paper pulp."—March 27, 1868.

1063. T. C. Currie, Kensington, Middlesex, "An improved process for the preservation of milk."

1067. J. C. Coombe, Holloway, Middlesex, and J. Poole, Chelsea, Middlesex, "Improvements in coating iron, steel, and such like surfaces, and protecting and preserving them from the corrosive action of sea or salt water, and the exicising influence of damp air, wet, and moisure."—March 28, 1868.

1071. H. Armstrong, Tow Law, Durham, "Improvements in the manufacture of steel and homogeneous iron."

1073. C. F. Claus, Middlesbrough-on-Tees, Yorkshire, "Improvements in the manufacture of iron."

1074. C. F. Claus, Middlesbrough-on-Tees, Yorkshire, "Improvements in the manufacture of malleable iron, and in the process of re-heating the same for the purpose of rolling or hammering it."

1076. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of cast steel and malleable iron from cast iron, and in the apparatus or means employed therein."—A communication from F. Ellershausen, Ottawa, Canada.

1077. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of cork, and in the manufacture of a new compound or material therefrom, applicable to various useful purposes."—A communication from H. Hauer and W. Howell, Philadelphia, Penn., U.S.A.

1078. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of cast steel, and in furnaces to be employed therein, which furnaces are also applicable to the remelting of metals generally."—A communication from F. Ellerhausen, Ottawa, Canada."

NOTES AND QUERIES.

Phosphate of Iron.—Can any of your correspondents give me the chemical composition of the precipitate resulting from the addition of a small quantity of dil. sulphuric acid to a solution of pyrophosphate of iron; and also the reason of its formation?—Pharmacist.

Solvent for Essential Oils.—Your correspondent desires to be informed whether it is possible to find a solvent for essential oils which would render these soluble in water, without producing therein a milky appearance. To a certain extent all essential oils are more or less soluble in water, but only very slightly so; still orange-flower water, for instance, shows that the fragrance due to the Oleum Neroli, as contained in the orange flowers, can be imparted to water in great measure. If "Subscriber" does not desire or want a perfectly limpid and clear solution, he may make use of the property possessed by essential, as well as fixed oils, of becoming more largely soluble in water by the intermediate of emulsions, or rather mixtures fit to make emulsions, with either essential or fixed oils. Another mode of rendering the essential oils soluble in water, without becoming milky, is to rub the essential oils in small quantity with some sugar and the ordinary magnesia of the chemists' shops in a mortar, to add water gradually, and to filter; gum arabic may be substituted for sugar, and by addition of a few drops of strong acetic acid or pure ether, or better yet acetic ether, the solvent power of water for essential oils may be somewhat increased. It is clear that a dilute alcohol will keep in solution a larger quantity of essential oils than water alone. It is, at least on the Continent, and also in Mexico, a well-known fact that the peculiarly delicious fragrance of the vanilla may be thoroughly imparted even to cold water or milk by first rubbing the vanilla to powder along with lump sugar, and gradually adding the water or milk afterwards, and straining through a silk sieve, or filtering; of course an infusion may be made, but its fragrance is less pleasant. "Subscriber" is, I suppose, aware that many essential oils have a boiling-point higher than that of water, and that if it is desirable to make a strong aqueous solution it is often desirable to use hot, but best distilled water, to shake a quantity of the essential oil with the hot water, and allow to cool in a closed or corked bottle, and decant the clear solution.—Dr. A. A.

Aniline Green.—In reply to "Test Tube," I can inform him that aniline green has been produced in the preparation of Hofmann's violet (salts of triethylrosaniline) in the following way:—The mixture which produces the violet colour is heated to 110°—115° C., not as in the production of violet, for four to six hours, but for a much longer time. After opening the apparatus and distilling off the excess of iodide and alcohol there is obtained a mixture of Hofmann's violet and a more or less bluish green colour, which may become even a greenish blue when the operation has been continued for a sufficiently long time. If there is too much violet in the mass, and the green is too blue, it is best to treat the whole once more with the iodide. Some manufacturers treat their product with iodide until the whole or almost the whole is transformed into a green colour, to which they give the yellower shades by adding picric acid.—Beta.

TO CORRESPONDENTS.

X. A. P.—Phosphorus is now generally purified by treating the crude product with sulphuric acid and bichromate of potash. The red phosphorus, it is said, becomes oxidised first, and rises to the surface in the form of a scum, while the pure phosphorus remains perfectly colourless and translucent at the bottom of the vessel.

W. L.—The work shall be sent by post.

Alfred K.—The term antimony-vermillion has been applied to sulphide of antimony, which, under certain conditions of preparation, exhibits a pure red colour.

Hardware.—Iron vessels must be used; they are not attacked by strong nitric acid.

Communications have been received from H. Saunders (with enclosure); W. Wallace; J. R. Atkinson; J. Richardson; W. Rose (with enclosure); T. Geeves (with enclosure); Kuhlmann & Co.; A. Losh; W. de Castro; Mr. Young (with enclosure); J. Owens; T. Hunt; F. Maxwell Lyte (with enclosure); J. A. Wanklyn; W. F. Barrett (with enclosure); J. S. Bouck; W. Huggon (with enclosure); C. Cochrane (with enclosure); W. Browning; Castle & Lamb; W. Blythe (with enclosure); R. Crook; E. Wheeler, jun.; Dunn & Co.; C. J. De Winton; F. C. Calvert & Co.; R. A. Macfie.

MEETINGS FOR THE WEEK.

Monday.—Royal Geographical, 8½.
Tuesday.—Royal Institution, 3. Dr. M. Foster, "On the Development of Animals."
— Photographic, 8.
Wednesday.—Microscopical, 8.
Thursday.—Royal Institution, 3. Sir John Lubbock, Bart., "On Savages."
— Royal Society Club, 6.
— Royal, 8½.
— Zoological, 8½.
Friday.—Royal Institution, 8. Prof. Frankland, "On the Source of Light in Luminous Flames."
— Astronomical, 8.
Saturday.—Royal Institution, 3. Sir John Lubbock, Bart., "On Savages."

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THE CHEMICAL NEWS.

Vol. XVII. No. 445.

ON THE ARTIFICAL FORMATION OF ORGANIC SUBSTANCES.*

By C. GREVILLE WILLIAMS, F.R.S.

Chemical researches are liable at various epochs to take special directions. Before 1830, organic chemistry was comparatively little studied. The simplification of the methods of organic analysis by Liebig, took place at a most opportune moment, and gave an extraordinary impetus to the study of carbon compounds. So great was this influence that proximate and ultimate analysis made a progress the rapidity of which was unexampled in the history of science.

But chemists soon became dissatisfied with merely determining the composition of substances, and they very soon began eagerly to study their products of decomposition, and in this manner get a clue to the way in which nature had put them together.

The successful attack on this problem led to a much grander one suggesting itself. This was to utilise the insight analysis had given them into the constitution of substances, and to endeavour to build them up without the assistance of life. The lecturer showed that we thus arrive at the two great engines of chemical research, *analysis* and *synthesis*.

He then proceeded to define and illustrate experimentally these terms.

In inorganic chemistry the information supplied by the analysis of a substance often renders its synthesis easy. Water was decomposed by a battery, and the properties and quantitative relations shown. The mixed gases were then introduced into a soap-bubble, so prepared as to last a considerable time. It was by a simple contrivance attached to a thread, and the lightness of the enclosed gases was shown by the fact that the bubble was able to raise the thread and a disc of paper into the air. The energy with which the mixed gases combine to form water, was then shown by applying a light to the bubble, when it burst with a loud report. This simple but delicate experiment was twice repeated successfully. The *quantitative* synthesis of water was experimentally shown by passing hydrogen over cupric oxide in an apparatus which allowed of the collection of the water. It was then shown that in organic chemistry the molecules are generally too complex to be put together so easily; and this statement was proved by reference to the constitution of methylamine, the simplest of the organic alkaloids.

The lecturer than went somewhat fully into the question of the propriety of the use of the terms "organic" and "inorganic." He showed also that all the attempts hitherto made at separating chemistry into two distinct branches had failed; Liebig's definition of organic chemistry as the "chemistry of compound radicles" being obviously inadequate, inasmuch as some compound radicles (such as sulphuryl and phosphoryl), are certainly inorganic.

Laurent's definition "chemistry of carbon," is equally insufficient, inasmuch as carbonic anhydride, and carbonic tetrachloride, are as clearly inorganic as sulphuric anhydride or sodic chloride. He then proceeded to argue that chemistry was "one and indivisible," and stated that one of the chief aims of his discourse was to prove that assertion.

It was shown that until within the last few years all the specific attempts made to break the apparently natural barriers between organic and inorganic chemistry had proved failures.

It was true that in the course of the innumerable researches and experiments made by chemists, one or two of the simple organic bodies had presented themselves; but like urea and cyanogen, they were substances which, as it were, hovered on the confines of inorganic chemistry, and would have been called inorganic had they not contained carbon.

The grand problem, which consisted in taking the elements themselves, and building them up *gradatim* into the proximate principles existing in the tissues of plants and animals, until lately appeared almost hopeless. This apparent difficulty was shown to arise from the mistake of supposing the proximate principles of animals and vegetables to result from an occult power vaguely termed the "vital force." It was at one time supposed that the laws which regulate combination, were either suspended or modified in the tissues of living creatures, but it was argued that, whenever the proper reagents were made to act upon each other under the proper conditions, the same substances were produced which at one time were supposed to require the aid of vitality for their formation.

The problem of the "synthesis," or building up of the so-called organic substances, was then shown to present itself (in the present state of chemistry) under two aspects:—1st. Where they are prepared by the aid of reagents, which have themselves been produced directly or indirectly from animals or vegetables. 2nd. Where the synthesis was effected from the free elements themselves, from hydrogen and pure carbon.

The lecturer then proceeded to enumerate some of the principal instances where substances originally derived from animals or vegetables had been formed synthetically. Wöhler's synthesis of urea was shown to be one of the earliest in point of date, and his method was described, and also Kolbe's new process by the mere heating of ammonic carbonate to a point just below that at which urea is decomposed.

One of the next most important steps in the history of synthesis was shown to be the conversion of carbonic disulphide into carbonic tetrachloride or perchlorinated marsh gas. Inasmuch as carbonic disulphide is a purely inorganic body, it is evident that the formation of any substance from it is a case of true synthesis.

The following equations represent the steps by which acetic acid may be produced from carbonic disulphide:—

$$\underbrace{CS_2}_{\substack{\text{Carbonic}\\\text{disulphide.}}} + 6Cl_2 = \underbrace{CCl_4}_{\substack{\text{Carbonic}\\\text{tetrachloride.}}} + \underbrace{2(SCl_4)}_{\substack{\text{Sulphuric}\\\text{tetrachloride.}}}$$

$$\underbrace{2(CCl_4)}_{\substack{\text{Carbonic}\\\text{tetrachloride.}}} = \underbrace{C_2Cl_4}_{\substack{\text{Carbonic}\\\text{dichloride.}}} + 2Cl_2$$

$$\underbrace{C_2Cl_4}_{\substack{\text{Carbonic}\\\text{dichloride.}}} + Cl_2 = \underbrace{C_2Cl_6}_{\substack{\text{Carbonic}\\\text{trichloride.}}}$$

$$\underbrace{C_2Cl_6}_{\substack{\text{Carbonic}\\\text{trichloride}}} + 2(H_2O) = \underbrace{C_2HCl_3O_2}_{\substack{\text{Trichloracetic}\\\text{acid.}}} + 3(HCl)$$

$$\underbrace{C_2HCl_3O_2}_{\substack{\text{Trichloracetic}\\\text{acid.}}} + 3H_2 = \underbrace{C_2H_4O_2}_{\substack{\text{Acetic}\\\text{acid.}}} + 3HCl$$

This important series of reactions, then, result in the production of acetic acid, one of the most marked of the so-called organic acids, from purely inorganic materials.

The synthesis of oxalic acid by the direct union of carbonic anhydride with sodium, as recently accomplished by Dr. Drechsel, was next described, and it was shown that as oxalic acid, by mere distillation, yields formic acid, the synthesis of the first acid led directly to a new synthesis of the second.

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* A lecture delivered before the Royal Institution of Great Britain, Friday, May 8th, 1868.

The other modes of effecting the synthesis of formic acid were then pointed out, viz.:—Berthelot's process, which consists in heating potassic hydrate in an atmosphere of carbonic oxide; and Kolbe and Schmidt's method, by exposing potassium to a warm moist atmosphere of carbonic anhydride.

The lecturer, in the course of his remarks on the constitution of formic acid, showed that the quantity of oxygen in it was so large that it only required one atom more to convert it into carbonic acid and water. Its easy oxidation was illustrated by letting it fall on plumbic dioxide in an apparatus which caused the evolved gas to pass into a solution of baric hydrate, the result being a copious precipitation of baric carbonate.

Having shown that acetic acid can be formed from carbonic disulphide and the chlorides of carbon, and oxalic and formic acids from the oxides of carbon, the lecturer proceeded to indicate the modes in which complex bodies, hitherto obtained from animal and vegetable sources, can be built up from elemental carbon and hydrogen.

If carbon can only be made to combine directly with hydrogen, no matter how simple the resulting compound may be, it becomes possible to effect the synthesis of a vast number of the most characteristic substances found in animals and vegetables.

This brilliant result has been accomplished through the agency of acetylene, a most remarkable hydrocarbon which was first noticed by Edmund Davy as long ago as 1836.

There are two methods by which acetylene can be formed from inorganic materials—one devised by Berthelot, and the other by the lecturer. The first consists in passing a stream of hydrogen through a globe in which the voltaic arc (from 70 or 80 cells of a Grove's battery) is produced between carbon points. At this tremendous temperature, the carbon unites directly with the hydrogen. The experiment was made, and the production of acetylene shown, by the formation of a precipitate in a solution of ammoniacal cuprous chloride.

The speaker then showed, experimentally, that much larger quantities of acetylene can be formed by the decomposition by the induction spark of carbonic tetrachloride in presence of hydrogen, in accordance with the equation—

$$2(CCl_4) + 5H_2 = C_2H_2 + 8(HCl).$$

The experiment succeeded perfectly, and a large quantity of the cuprous acetylide was rapidly produced.

But the most simple and ready means of preparing acetylene was shown to be by drawing air through the flame of a common glass spirit lamp, by means of an aspirator. So readily is the cuprous precipitate obtained by this means, that it suffices to draw a few cubic centimetres through the solution of ammoniacal cuprous chloride to obtain evidence of the presence of acetylene in the flame. In a few seconds the solution became quite thick with the suspended precipitate.

All the homologues of olefiant gas give acetylene in abundance when subjected to the induction spark. Amylene does it readily in accordance with the annexed equation:—

$$2\underbrace{(C_5H_{10})}_{\text{Amylene.}} = 5\underbrace{(C_2H_2)}_{\text{Acetylene.}} + 5H_2.$$

That the spark acted only in consequence of its high temperature, the speaker said, is rendered probable by the fact that if hydrogen be passed through carbonic tetrachloride, and then into a globe containing a platinum spiral, when the latter was heated to dull redness by three cells of a Grove's battery, no acetylene was produced; but when five cells were used, and the spiral became white hot, the cuprous precipitate was obtained readily. The same result was stated to occur with amylene.

Simple as the formula of acetylene is, almost all the animal and vegetable substances which have been formed by pure synthesis may be obtained from it.

The following equations represent the steps by which alcohol may be "synthesised." It is proper to premise that the conversion of acetylene into olefiant gas is accomplished by treating the cuprous acetylide with zinc and ammonia, so as to obtain nascent hydrogen:—

$$\underbrace{C_2H_2}_{\text{Acetylene.}} + H_2 = \underbrace{C_2H_4}_{\text{Ethylene.}}$$

$$\underbrace{C_2H_4}_{\text{Ethylene.}} + H_2SO_4 = \underbrace{H, C_2H_5SO_4}_{\substack{\text{Ethyl-sulphuric}\\ \text{acid.}}}$$

$$\underbrace{H, C_2H_5SO_4}_{\substack{\text{Ethyl-sulphuric}\\ \text{acid.}}} + H_2O = \underbrace{C_2H_6O}_{\text{Alcohol.}} + H_2SO_4.$$

The synthesis of succinic acid from acetylene was next shown in accordance with the annexed equations, omitting the synthesis of ethylene, which has been already given:—

$$\underbrace{C_2H_4}_{\text{Ethylene.}} + Br_2 = \underbrace{C_2H_4Br_2}_{\substack{\text{Ethylenic}\\ \text{dibromide.}}}$$

$$\underbrace{C_2H_4Br_2}_{\substack{\text{Ethylenic}\\ \text{dibromide.}}} + 2\underbrace{(KCN)}_{\substack{\text{Potassic}\\ \text{cyanide.}}} = \underbrace{C_2H_4(CN)_2}_{\substack{\text{Ethylenic}\\ \text{dicyanide.}}} + 2(KBr)$$

$$\underbrace{C_2H_4(CN)_2}_{\substack{\text{Ethylenic}\\ \text{dicyanide.}}} + 2(KHO) + 2(H_2O) = \underbrace{C_4H_4K_2O_4}_{\substack{\text{Potassic}\\ \text{succinate.}}} + 2(NH_3).$$

This mode of effecting the synthesis of succinic acid is due to the researches of Maxwell Simpson.

The beautiful appearance of succinic acid under the influence of polarised light was shown by the aid of the electric lamp. The specimen used having been artificially prepared.

The speaker then proceeded to show that the synthesis of succinic acid was a direct step to that of tartaric acid. This latter reaction is due to the researches of Perkin and Duppa.

The artificial formation of succinic acid, starting with acetylene, having been proved, it is only necessary to start with that acid to prove the synthesis of tartaric acid from acetylene:—

$$\underbrace{C_4H_6O_4}_{\substack{\text{Succinic}\\ \text{acid.}}} + 2Br_2 = \underbrace{C_4H_4Br_2O_4}_{\substack{\text{Dibromosuccinic}\\ \text{acid.}}} + 2HBr$$

$$\underbrace{C_4H_2Ag_2Br_2O_4}_{\substack{\text{Argentic}\\ \text{dibromosuccinate.}}} + 2(H_2O) = \underbrace{C_4H_6O_6}_{\substack{\text{Tartaric}\\ \text{acid.}}} + 2(AgBr).$$

The lecturer next proceeded to show how the synthesis of the organic alkaloids could be effected from inorganic materials.

In the first place the fact that cyanides can be produced by heating carbon in presence of nitrogen and an alkali, is well known. The next step is to procure prussic acid by distilling cyanides with acids. From pure prussic acid methylamine, the simplest of the primary monamines, can easily be obtained, either by the aid of nascent hydrogen, or free hydrogen in the presence of spongy platinum.

$$\underbrace{CHN}_{\text{Prussic acid.}} + 2H_2 = \underbrace{CH_5N}_{\text{Methylamine.}}$$

This equation has been realised by both the methods given above, the first by Mendius, the second by Debus.

It is also evident that as alcohol can be obtained from acetylene, so all the ethylic, primary, secondary, and tertiary monamines of Hofmann can now be synthetically formed. The steps being (1), conversion of acetylene into olefiant gas. (2). Passage of olefiant gas into alcohol. (3). Alcohol into iodide of ethyl. (4). Action of iodide of ethyl on ammonia.

Again, acetic acid, it has been shown, can be prepared from carbonic disulphide. Now acetic acid, by the action of a red heat, can be made to yield a number of the homologues of olefiant gas. The latter, by treatment with excessively strong hydriodic acid, become converted into the iodides of the alcohol radicals (Berthelot). By following up this last reaction with pentylene, heptylene, octylene, and nonylene, the lecturer succeeded in obtaining pentylamine, heptylamine, octylamine, and nonylamine.

The direct ascent from acetylene to the coal tar colours was then shown according to the following equations :—

$$\underbrace{3(C_2H_2)}_{\text{Acetylene.}} = \underbrace{C_6H_6}_{\text{Benzol.}}$$

$$\underbrace{C_5H_6}_{\text{Benzol.}} + HNO_3 = \underbrace{C_6H_5NO_2}_{\text{Nitrobenzol.}} + H_2O$$

$$\underbrace{C_6H_5NO_4}_{\text{Nitrobenzol.}} + 6(FeO) + H_2O = \underbrace{C_6H_7N}_{\text{Aniline.}} + 3(Fe_2O_3)$$

$$\underbrace{C_6H_5Br}_{\text{Bromobenzol.}} + \underbrace{CH_3Br}_{\substack{\text{Methylic}\\\text{Bromide.}}} + Na_2 = \underbrace{C_7H_8}_{\text{Toluol.}} + 2\ NaBr$$

$$\underbrace{C_6H_7N}_{\text{Aniline.}} + \underbrace{2(C_7H_9N)}_{\text{Toluidine.}} = \underbrace{C_{20}H_{19}N_3}_{\text{Rosaniline.}} + 3H_2$$

These transformations were all described at length. In effect acetylene passed through a red hot tube becomes polymerised into benzol.

The passage of toluol into nitro-toluol and toluidine is omitted in the above equations, because the reactions are identical in kind with those of benzol into aniline.

In describing benzol, experiments were shown illustrating the density of its vapour as compared with air. In one of these, benzol was poured into a large beaker containing a hot iron; at first the benzol assumed the spheroidal form, but, as the temperature fell, it became converted into vapour, which filled the beaker. A glass syphon was then introduced into the beaker, and the vapour drawn off as if it had been a liquid, and inflamed. The vapour descending through the syphon was then received into a warm beaker, from which it was decanted into another beaker in which it was inflamed.

The speaker then proceeded to show the way in which the synthesis of zinc ethyl could be effected; it is, however, unnecessary to follow the equations in detail, because, having already explained the manner in which alcohol can be synthesised from acetylene, it is obvious that zinc ethyl can be directly derived from that fluid.

Wanklyn's interesting synthesis of acetic acid from sodium methyl was then shown to take place in accordance with the expression—

$$\underbrace{CH_3Na}_{\text{Sodium methyl.}} + CO_2 = \underbrace{C_2H_3NaO_2}_{\text{Sodic acetate.}}.$$

The method appears to be general, inasmuch as the same chemist has effected the synthesis of propionic acid :—

$$\underbrace{C_2H_5N}_{\text{Sodium ethyl.}} + CO_2 = \underbrace{C_3H_5NaO_2}_{\text{Sodic propionate.}}$$

And, substituting carbonic oxide for carbonic anhydride, we have—

$$2(CH_3Na) + CO = \underbrace{C_3H_6O}_{\text{Acetone.}} + 2Na.$$

The speaker stated that one of the most interesting of the cases of synthesis recently accomplished was that in which Mr. W. H. Perkin had succeeded in producing artificially the odoriferous principle of new hay and the tonquin bean.

The delicious fragrance of new hay is entirely due to the presence of the sweet scented vernal grass, *anthoxanthum odoratum*. It is the same substance which is the cause of the sweet smell of the woodruff, *asperula odorata*; the melilot, *melilotus officinalis*. It is also the flavouring ingredient in the *mai wein* of the Germans, which is perfumed with woodruff.

Until lately, nothing was known about coumarin, except that it was a colourless crystalline body, having the formula—

$$C_9H_6O_2.$$

The crystals of coumarin appear very beautiful under the influence of polarised light. The image of some artificial coumarin, which had been fused and allowed to crystallise in a plate of glass, was then thrown upon the screen, and the light being polarised by the aid of Nicol's prisms, the crystals assumed the most gorgeous and varying colours as the prisms were rotated.

The clue to its constitution was shown to be the circumstance that when heated with potassic hydrate it yields salicylic and acetic acids. The production of salicylic acid from coumarin was then shown, experimentally, the presence of the acid being proved by its yielding a deep purple colouration with ferric chloride.

Artificial coumarin was obtained from the hydride of salicyl. By treatment with sodium it yielded hydride of sodium salicyl; this substance, heated with acetic anhydride, gave hydride of aceto-salicyl. This last substance was then distilled with acetic anhydride and sodic acetate, and when the temperature reached 290°, the distillate solidified to a mass of crystals of pure coumarin, having all the fragrance and beauty of that obtained from the tonquin bean.

The speaker submitted that the assertion he had made at an early period of his lecture that there was no natural barrier between organic and inorganic chemistry, had been amply proved by the instances he had brought forward. He said that they had studied together that evening several cases where, starting from inorganic matter, they had ascended step by step until they had reached some of the most complicated bodies secreted by animals and vegetables. What, he said, could be more distinctly inorganic than nitrogen, carbon, and oxygen? What more distinctly an animal secretion than urea? What more completely inorganic than acetylene? What more distinctly vegetable in origin than coumarin?

Chemists have then, so far, done what a very few years ago would have been regarded as possible only by the aid of the vital force. A true organic substance, he said, is so definite that we can almost invariably determine its molecular weight, and it is generally crystalline. But when we come to the tissues we are dealing no longer with organic substances, but with organised beings, and we feel that we are approaching the barriers which separate the study of life from the study of matter. The bonds which unite them are so close that we cannot imagine life *without* matter, and it is equally difficult to conceive the assumption of vitality *by* matter, but we must never cease to look anxiously for the solution of the problem. The impossible is a horizon which recedes as we advance, and the *terra incognita* of to-day will to-morrow be boldly mapped upon every schoolboy's chart!

Artificial Gems.—The base of these gems, as patented by the superintendent of the Royal Porcelain Works at Berlin, is a flux obtained by melting together 6 drachms of carbonate of soda, 2 drachms burnt borax, 1 drachm saltpetre, 3 drachms minium, and 1½ ounces of purest white sand. To imitate in colour, but of course not in composition, the following minerals, add to the flux the ingredients named in connection with each gem:—*Sapphire.*—10 grains carbonate of cobalt. *Opal.*—10 grains oxide of cobalt, 15 grains oxide of manganese, and from 20 to 30 grains protoxide of iron. *Amethyst.*—4 to 5 grains carbonate of peroxide of manganese. *Gold Topaz.*—30 grains oxide uranium. *Emerald.*—20 grains protoxide of iron, 10 grains carbonate of copper.

CHEMICAL CONSTITUTION AND ITS RELATION TO PHYSIOLOGICAL ACTION.*

By Dr. A. CRUM BROWN, F.R.C.P. Edin., &c.

Chemical *composition* is an expression which has a perfectly definite meaning. By it we understand the proportions of the elements (or hitherto undecomposed substances) which can be obtained from a substance, or from which it can be built up.

In investigating the composition of a substance it is a matter of secondary importance *how* it has been decomposed or *how* it may be reconstructed; what we wish to know is, what are its ultimate constituents, and how much of each it contains. The knowledge of the intermediate steps is only valuable so far as it is necessary to prove that we have lost nothing and added nothing. It is quite different when we come to consider chemical *constitution*. Here we have to deal not only with the nature and quantity of the constituent elements, but with their relations to each other in the compound. The difference between composition and constitution may be illustrated by very many analogies. I shall make use of a familiar one. The *composition* of a household is expressed by the number of persons contained in it, with the sex and age of each, but its *constitution* is not known, until we have the relations in which they stand to one another, as husband and wife, parents and children, master and servant, &c.

If we assume the existence of atoms, we may define constitution as the relation of the atoms to one another in the compound, just as the constitution of a family is the relation of the individuals composing it to one another. We have now to inquire, how these relations may be discovered, and how they may be expressed. We discover them by examining the way in which the compound is built up or decomposed, and we express them by means of "rational" or "constitutional" formulæ. In the case of the family alluded to above, we should know the constitution if we knew the history, that is, if we knew by what steps these particular individuals came to live together in one house; and in the same way, the history of a compound, or the steps by which it was produced from its elements, leads us to a knowledge of its constitution. As, however, the work of destruction is generally easier than that of construction, we are often obliged to take the course of gradually, so to speak, picking the compound to pieces, and learning its history backwards.

It would be out of place for me here, even did time permit, to give detailed examples, showing how the constitution of particular substances may be determined: a very clear account of the subject will be found in the article, "Formulæ, Rational," by Professor G. C. Foster, in Watts's "Dictionary of Chemistry." It is sufficient here to indicate some of the general results. We believe, then, that the atoms in a compound are related to one another in such a way that atom is united to atom, and that when two groups of atoms unite together, it is by individual atoms of the one uniting with individual atoms of the other. We find that the atoms of some elements can each enter into only one relation, those of some into two, those of some into three, &c; such atoms are called monatomic, dyatomic, triatomic, &c., respectively; if we prefer English to Greek names, we may call them singly-related, doubly-related, and so on. We find, further, that an atom which in one compound is singly-related, becomes in another trebly- or fivefold-related, and that a doubly-related atom may, in the same way, become fourfold- or sixfold-related; the change in the number of relations (what is called the change of "atomicity") taking place, in the vast majority of cases, by two at a time, so that an atom which has an odd number of relations in one compound has an odd number in all, and may, therefore be called *oddly-related* ("perissatomic"), and an atom which has an even number in one, has an even number in all, and may be called *evenly-related* ("artiatomic").

These relations have been expressed in a great variety of ways; most completely by the system of "graphic formulæ," first introduced by Professor Kekulé in 1859. These graphic formulæ have received many modifications; in one of these, which I proposed in 1861, each atom is represented by a circle containing the symbol of the atom, and the relations by lines proceeding outwards from the circumference and connecting the circle with others. Such graphic or pictorial representations have not unfrequently been objected to as expressing more than we know, and as leading readers to imagine that they show the relative *position* of the atoms, of which, of course, we are entirely ignorant. I think I shall be able to show you that this accusation is unfounded, and, at the same time, illustrate the meaning of chemical constitution, by applying the same graphic method to a case where the idea of position in space does not enter at all. Let us suppose that John is occupant of a house which belongs to Mr. Smith, and is situated in Edinburgh, and that Thomas occupies a house belonging to Mr. Brown in Glasgow; then representing John by J, his house by E, Smith by S, Thomas by T, his house by G, and Brown by B, we may express their relations thus: $\begin{array}{l} S \\ | \\ E-J \end{array}$ and $\begin{array}{l} B \\ | \\ G-T \end{array}$ without meaning that the landlord is situated above and the tenant at the side of the house. Now if it is convenient for John to go to Glasgow and Thomas to Edinburgh, they may change houses, and we have $\begin{array}{l} S \\ | \\ E-J \end{array}$ and $\begin{array}{l} B \\ | \\ G-T \end{array}$ becoming $\begin{array}{l} S \\ | \\ E-T \end{array}$ and $\begin{array}{l} B \\ | \\ G-J. \end{array}$ Here we have two groups, one in Edinburgh and one in Glasgow, before the change and after it. The only difference is, that we have John and Thomas each in the position previously occupied by the other. These two men may be totally unlike in every other respect, but they are capable of replacing each other in this particular relation. So in chemistry; when chloride of sodium and nitrate of silver are brought together, the silver and the sodium change places, each taking up the relations previously held by the other. This is an example of what is called double decomposition.

Now let us suppose a slightly more complicated case. Let John be proprietor as well as occupant of his house. Here we have $E = J$ and $\begin{array}{l} B \\ | \\ G-T. \end{array}$ In this case John is doubly-related and united by both bonds to the house. If he *now* change with Thomas, the state of matters will be represented thus: $\begin{array}{ll} B & \\ | & \\ G- & J \\ & | \\ & E-T. \end{array}$ Before the change *two* groups, but only *one* after. The corresponding chemical reaction is termed addition, and groups to which addition can be made in this way are said to be *condensed*. The condensation obviously consists in the atoms being united together by more bonds than are necessary to ensure the unity of the group. Thus J and E are united by two bonds, while one would be sufficient. We have an instance of this kind of addition in the union of chlorine and olefiant gas. The two carbon atoms of olefiant gas are doubly-related to one another; by the action of chlorine one of these relations is broken, and each carbon atom becomes related to a chlorine atom.

Addition may take place in another way, namely, by an increase in the number of relations of an atom: thus in ammonia, nitrogen is trebly-related, being united to three atoms of hydrogen, but when ammonia is brought into contact with hydrochloric acid, chloride of ammonium is formed, the nitrogen becoming fivefold-related, being united to four atoms of hydrogen and one of chlorine. We may illustrate this by supposing that John, who is already doubly-related, borrows £1000 from Robinson, and buys another house, thus entering into *two* new relations, one to his creditor and one to his investment. Now if we offer Robinson a better investment, he will call up his money from John, who must either borrow from some one else or sell one of his houses. Both cases occur in chemistry; if we mix caustic potash with chloride of ammonium, we offer, so to speak, the better investment of potassium to the chlorine, which accordingly leaves the nitrogen, but the nitrogen, at the same time, loses one atom of hydrogen, just as John parted with his creditor and one of his houses together; but if we try a similar experiment with the chloride of a complex ammonium (such as chloride of tetramethylammonium), mixing it, say, with moist oxide of silver, and thus tempting the chlorine to leave the nitrogen and unite with silver, the nitrogen does not lose a methyl atom long with the chlorine, but, if I may use the expression, pays off the chlorine by borrowing from oxygen. This analogy might be carried much further, but it is unnecessary to do so. My object is attained if I have shown that *any* kind of relation which can be single, double, treble, &c., may be used to illustrate chemical constitution, and that we are not necessarily restricted to geometrical relations.

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* Read before the Pharmaceutical Meeting, Edinburgh.

Our time does not allow me to dwell longer on this part of the subject; I shall, therefore, proceed to the consideration of the relation between chemical constitution and physiological action.

The difficulty of determining this relation depends mainly on our ignorance of the constitution and action of the great majority of substances, which makes it impossible for us to make much progress by direct comparison of constitution with action. All that has been made out in this way is, that the soluble compounds of what we may call a poisonous element, such as lead, have all nearly the same action, and similarly of a poisonous radical, such as cyanogen. Here, however, we meet some remarkable exceptions; thus, kakodylic acid, although readily soluble, and containing a large amount of arsenic, is inert, and a number of the double cyanides, such as ferrocyanide of potassium, show no trace of the action of hydrocyanic acid.

In this difficulty it occurred to Dr. Fraser and myself, that another method of inquiry might lead to better results. The method which we have adopted consists first, in introducing a known change into the constitution of an active substance; and, second, in comparing the action of the new product so formed with that of the original substance.

The first set of substances to which we applied this method (in an investigation communicated to the Royal Society of Edinburgh, January 6, 1868) was the group of vegetable alkaloids, and we have treated in this way strychnia, brucia, thebaia, morphia, codeia, and nicotia. Each of these alkaloids contains a trebly-related atom of nitrogen, which can easily be made fivefold-related. We do not know what its original three relations are, but we know what the two new ones are which we introduce. Thus, confining our attention to strychnia (and what is said of it applies with slight modification to the others), we find that a molecule of that alkaloid contains two atoms of nitrogen; of the connections of one of these we know nothing, of the other we know that it is trebly-related, and that we can make it enter into two new relations. We can do this by uniting it to an acid, hydrochloric acid for instance, in which case the new relations are, one to hydrogen and one to chlorine; to use the old metaphor, it borrows from chlorine and invests in hydrogen. We cannot, however, compare the action of strychnia with that of its hydrochlorate, for a very slight inducement is all that is necessary to make chlorine call up its investment, and retire with an atom of hydrogen. To try the effect of addition we must add two new relations of a more stable kind. This is done by acting on strychnia, not with an acid, that is a compound of hydrogen, but with an ether or compound of methyl or ethyl, such as iodide of methyl or iodide of ethyl. Here the nitrogen borrows from iodine and invests in methyl or ethyl, and the resulting compound is so stable that it has no tendency to recur to its former state. These peculiar compounds were first studied chemically by How, and afterwards by Stahlschmidt. The latter made some experiments with methyl-strychnium salts on rabbits, and came to the conclusion that they were quite inert. A more complete examination has shown that this is not exactly true, but that a still more remarkable change has been produced. Large doses (thirty grains) of the iodide of methyl-strychnium (the compound of strychnia with iodine and methyl) produce no effect whatever when administered to a rabbit by the stomach; fifteen grains, however, kill a rabbit when injected under the skin. In this case the symptoms are quite unlike those of strychnia poisoning; instead of violent tetanic convulsions, we observe a condition of general paralysis. Now it is important that we should know *how* this paralysis is produced, and for this purpose we had recourse to a method which has been very successfully applied to the study of various poisons, especially "urali" or "curare," the South American arrow poison. To make this method of experimenting intelligible, I shall compare the nervous system to a set of telegraph-wires and offices. Let us suppose that every town in the country has two telegraph offices, and that each is connected by a wire with the head office in London, one of the wires is used only for sending messages up to London, the other only for sending messages down, and there is no means of telegraphic communication between one country town and another, except through London. Let us further suppose that whenever a message from London is received in any town the town bell is rung; now if we give in a message at the Manchester office, intending it to go through London to every town in the country, and find that no bells are rung, it is obvious that something is wrong; it may be, first, that the apparatus at Manchester is out of order, so that the message was never sent; or, second, that the up wire from Manchaster was broken or not insulated, so that the message never reached London; or, third, that there was something wrong at the head office; or, fourth, that all the down wires were broken or not insulated; or, fifth, that something was wrong at all the receiving offices throughout the country; or, sixth, that the bells could not be rung. When a healthy frog is pinched anywhere the animal jumps, a message is sent from the part of the skin pinched to the nerve-centres, and thence to all the muscles; but if we give the frog iodide of methyl strychnium a pinch produces no effect. As in the supposed telegraphic case this result may be due to one of six causes,—first, the ends of the sensory nerves may be injured, so that the message is never sent from the place pinched; or, second, the sensory nerve-trunks may be paralysed, so that the message does not reach the nerve-centres; or, third, the nerve-centres, may be so deranged that they do not send it on to the motor nerves; or, fourth, the motor nerve-trunks may be paralysed; or, fifth, the terminations of the motor nerves may be injured, so that they do not communicate the stimulus to the muscular fibres; or, sixth, the muscular fibres themselves may be incapable of contracting.

To return to the supposed telegraph case,—if we could ensure that the whole apparatus within some one county at a distance from London, say Cumberland, were in good order, and found that the bells rung in Cumberland, and nowhere else, when a message was sent from Manchester, we should know that the mischief was not in the apparatus for sending the up message, nor in the up wires, nor in the head office, nor in the down wires, for to reach Cumberland the message had to pass through districts where the injury existed; the fault must be either at the receiving offices or in the bells. If now we can go directly to the bells throughout the country, and find that they can be rung, we prove the fault to lie at the receiving offices. In the case of the frog, we can, by trying the artery of one leg, prevent the poison from reaching that leg, which thus represents Cumberland in the case above; if the frog be now pinched *anywhere* he kicks with the unpoisoned leg, proving, as above, that the poison does not act on the terminations of the sensory nerves, nor on the trunks of the sensory nerves, nor on the nerve-centres, nor on the motor nerve-trunks, but that its action must be either on the terminations of the motor nerves, or on the muscular fibres. But we find that the muscles contract when directly stimulated, showing that they are not injured, and we thus prove that the paralysis is produced by a destruction of the power of the terminations of the motor nerves to receive the stimulus and transmit it to the muscles.

Strychnia produces tetanic convulsions, by exciting the nerve-centres in the spinal cord, but the substances formed by rendering the trebly-related nitrogen atom of strychnia permanently fivefold-related produce paralysis, and do so in the very remarkable way described above. Not only is this the case with strychnia, but we have found that the same change is produced in every alkaloid we have examined, which has an action like that of strychnia.

It will be seen that we have as yet made but little progress towards the solution of the very important question, What is the relation between chemical constitution and physiological action? We may, however, reasonably expect that a series of investigations, such as that sketched above, will throw a good deal of light on the subject.

ON THE RELATION BETWEEN
THE MAGNETISM OF SOME METALS,
AND THEIR
ATOMIC AND SPECIFIC WEIGHTS.[*]

By P. H. VAN DER WEYDE, M.D.

When we divide the specific gravity of the different metals respectively into their atomic weights, we obtain quotients which indicate, not directly, but relatively, the distance of their atoms; (upon the supposition that the atomic weights indicate really the relative weights of their atoms, which is only probable, but not proved): comparing those quotients in the subjoined table, we find the following remarkable results:—

	Sp. Gr.	Atomic Weight.	Quotient.
Cobalt	8·5	30·	3·53[†]
Iron	7·8	28·	3·59[‡]
Chromium	6·8	26·	3·82[∥]
Nickel	8·	31·	3·90[§]
Manganese	7·	27·6	3·94[¶]
Palladium	11·8	53·	4·49
Platinum	21·5	99·	4·57
Zinc	6·8	32·5	4·78
Aluminium	2·56	13·7	5·35
Iridium	16·	99·	6·2
Cadmium	8·7	56·	6·4
Magnesium	1·74	12·	7·
Mercury	13·5	100·	7·47
Lead	11·4	104·	9·12
Osmium	10·	100·	10·
Gold	19·4	196·	10·005
Silver	10·47	108·	10·3
Lithium	0·593	6·4	10·9
Antimony	6·7	130·	19·4
Bismuth	9·8	208·	21·22

Observations.

1st. The five magnetic metals have all quotients below 4.

2nd. The so-called non-magnetic metals have all quotients above 4.

There is, however, one exception to this rule, in the case of copper, of which the respective specific and atomic weights are 8·8 and 31·7, of which the quotient is 3·602; but then it is probable that the atomic weight of copper needs correction, and should be doubled to 63·4, in which case the quotient would be 7·204, and it would then fall among the other non-magnetic metals.

3rd. The quotients are the smallest for those metals which are the most permanently magnetic, even at high temperature, and *vice versa*.

4th. As cooling increases by contraction the number expressing the specific gravity, it will consequently decrease the quotient obtained by using this increased specific gravity as a divisor, in perfect accordance with the fact that cooling increases the paramagnetic property.

5th. As, inversely, heating decreases by expansion the specific gravity, it will increase this quotient, in accordance with the fact that heat diminishes paramagnetism, and finally destroys it in all metals with the single exception of cobalt, which has the smallest quotient of all, and consequently can stand some increase.

6th. The experiments of Faraday on diamagnetism and paramagnetism, with very powerful electro-magnets, have proved that palladium and platinum are the strongest paramagnetic next to the first five in the above list: they have in my list, also, the smallest quotients connected with them.

7th. In the same way as diamagnetism is the opposite of paramagnetism, the larger quotients in the above table belong to diamagnetic bodies, as, for instance, mercury, antimony, and bismuth. The last is the strongest diamagnetic substance experimented upon, and possesses the greatest quotient in the above table.

8th. If we were able to cool the other metals so as to increase their specific gravities to such a degree as to have a decided effect on the amount of this quotient, we might perhaps succeed in discovering in several of them paramagnetic qualities, by means of Faraday's apparatus.

9th. Heating decreases the paramagnetic qualities, with the specific weight, and consequently increases the quotient. That it may do this to such a degree as to make the body diamagnetic, is proved in the case of oxygen gas, which, when cool is paramagnetic like iron, and when hot, diamagnetic like bismuth.

10th. That this relative distance of the atoms (upon which, of course, the specific gravity of bodies depends) is closely related to their magnetism, is again proved by their crystals, which are always less dense in the direction of their optical axis, and expand by heat more in one direction than in another; and Pluecker has demonstrated that they are diamagnetic in the direction of their optical axis, or of the longest axis of crystallisation. In some of these crystals, this action is so strong that they are influenced by the magnetism of the earth; as, for instance, a properly cut crystal of kyanite (a dense silicate of alumina) when suspended on an axis, will behave like a compass needle, and may be used as such, a fact little known, but worth knowing.

Hydrocarbons of the CH_{2n} Series.—A. Butlerow has compared the reactions of the propylene derived from allylic iodide and iodhydric acid with those of the propylene from amylic alcohol, and arrived at the conclusion that they are identical, their composition being represented by the formula $\left\{\begin{matrix}CH_3\\CH\\CH_2\end{matrix}\right.$ —(*Zeitschr. Chem.*, N.F. iii., 602.)

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[*] *American Journal of Mining.*

[†] Remains paramagnetic at white heat.

[‡] Is only magnetic below bright red heat.

[∥] Is only magnetic below dark red heat.

[§] Is only magnetic below 600 Fahr.

[¶] Is only magnetic below 4 Fahr.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 4.

Dr. Warren de la Rue, F.R.S., &c., President, in the Chair.

The minutes of the previous meeting were read and confirmed, and the donations to the library announced. Messrs. G. W. Brown and James Richards were formally admitted Fellows of the Society; and the following gentlemen were balloted for and duly elected, *viz.*:—Henry Chance, M.A., glass manufacturer, Oldbury, near Birmingham: William Hustler, mining engineer, Rosemerryn, Falmouth; and William B. Miller, assayer, Royal Mint, Sydney.

There were no new candidates proposed. For the second time were read the names of the following gentlemen, viz.:—Samuel Alexander Sadler (at Messrs. Chance's Chemical Works), Oldbury, near Birmingham, and H. B. Riddel (late of the Indian Civil Service), 9, Stratton Street, Piccadilly.

Mr. E. T. Chapman gave a short account of the reactions more fully described in three papers presented to the Society, of which Mr. Miles H. Smith and himself were joint authors.

I. "*Action of Chloride of Zinc on the Oxalic Ethers.*" Having sketched the chemical changes which were possible under these circumstances, the authors show that the action of the metallic dehydrating agent upon the oxalates of ethyl, amyl, and methyl, results in the formation of oxalate of zinc (left as a residue in the retort), but instead of obtaining the chlorides of these radicals as the direct result of a double decomposition, they are split up into hydrochloric acid and the olefines, or a mixture of bodies of the latter class; only in the last-named instance was a small quantity of chloride of methyl produced.

II. "*On the Artificial Production of Pyridine.*" Referring to Mr. Perkin's researches on this subject, and to a previous speculation as to the possibility of inducing the formation of articifial pyridine (*Chem. Soc. Jour.*, August, 1866), the authors now show that this body may be produced in small quantity by the action of anhydrous phosphoric acid upon the nitrate of amyl. The principal product of the reaction is a dark brown pitch-like substance, but a sufficient amount of pyridine was obtained upon distilling with potash, to permit of its identification, and of an analysis being made of its chloride, C_5H_5N,HCl.

III. "*Isomerism in the Organic Cyanides.*" On a review of Dr. A. W. Hofmann's researches on the isomeric cyanides, it appeared to the authors desirable to attempt the formation, and study the characters of compounds produced by the action of dehydrating agents, such as anhydrous phosphoric acid, and fused chloride of zinc, upon the formamides obtained by acting with formic ether upon ammonia, ethylamine, aniline, and other amines. The products of these reactions were the so-called pseudo-cyanides, and were at once recognised by their peculiar odour, and by the decompositions they underwent upon treatment with acids. This method of proceeding cannot be considered available for the preparation of these cyanides in large quantity, and an attempt to obtain analogous bodies from the compound acetamides did not prove successful.

Dr. B. H. Paul then gave an account of "*The Modes of Testing Mineral Oils used in Lamps,*" in which he showed that the results obtained as indicating the degree of inflammability of this oil were subject to considerable variation according to the mode in which the test was applied. It was also shown that there was a difference of opinion as to what should be regarded as the firing point, whether it was to be the temporary firing of the first small portion of oil vapour given off or the permanent firing of the oil itself. Between these two results there might be a difference of from ten to twenty degrees Fahrenheit, according as the oil was tested in a shallow open basin, or a partially closed vessel. In reference to the influence of the degree of inflammability of mineral lamp oil on the possibility of accidents occurring in the use of this material, it was shown that the mere volatility of the oil was not the only point to be considered, and that, apart from misuse and carelessness, the construction of the lamps in which it was burnt was of considerable importance. To illustrate this, a lamp filled with what is commonly known as spirit or naphtha (the most volatile portion of petroleum or paraffin oil), was kept burning during the meeting. This lamp was so constructed, that there was no communication between the flame and the oil reservoir, except through the tube containing the wick, and consequently there was no chance of oil vapour or an explosive mixture of it with air coming in contact with the flame, so as to cause accident. Other kinds of lamps in which there is free communication between the oil reservoir and the flame, afford less security, especially when the oil used in them vaporises at a low temperature.

The mode of testing oil, and the possible variation of the results obtained under different conditions were illustrated by experiments; and an apparatus devised by Mr. Rippingille, of the Albion Lamp Company, was shown. It consisted of a small copper vessel like a paraffin oil lamp fitted with a thermometer, and a valve, and two wires, by which an electric spark could be produced inside the vessel. By gradually heating the oil to be tested in this vessel, and passing the spark from time to time while the temperature was observed, a point was at length reached when there was a slight explosion, and this was taken as the firing point of the oil.

In conclusion, the author pointed out that whatever degree of inflammability was fixed upon as the proper minimum for safety, the mode of testing should be precisely defined, and the experiment should always be made under like conditions.

A short discussion followed, in which Messrs. Dugald Campbell, E. T. Chapman, and Dr. Attfield took part. The general conclusion arrived at was that the danger from explosion had been greatly exaggerated, and that when such events occurred they might sometimes be traced to faults of construction in the lamp. It was generally agreed that an oil which does not give off inflammable vapour below 100° Fahr., should be accounted safe, but no precise figure below this point on the thermometric scale was adopted at the meeting, although Mr. Dugald Campbell, amongst other speakers, pressed for a decision to support his own judgment in the matter.

The President, in moving a vote of thanks to Dr. Paul, took occasion to support his view of the case, namely, that the construction of the lamp was as important as the firing point of the petroleum, and that the dangers of explosion had been greatly overrated.

The meeting was then adjourned until Tursday, the 18th instant, which will be the last during the present session.

Carbolic Soap.—The beneficial effects experienced by the use of the medical carbolic soap, have led the patentees, Messrs. McDougall, Bros., to introduce it in a form suitable for the toilet. The antiseptic properties of carbolic acid are well known to our readers, and the form in which it enters into the composition of this soap renders its use pleasant, refreshing, and perfectly harmless. We have no doubt that as the soap becomes known it will be more appreciated, and command an extensive sale. Messrs. McDougall, Bros., are also manufacturing a common carbolic soap for household use, which is valuable for cleansing purposes, and also to prevent contagion.

FOREIGN SCIENCE.

Paris, June 10, 1868.

New polarising apparatus.—Testing colouring matters.—Ferric hydrate and ferric chloroxide. Academy of Sciences: New substance replacing magnesia in the oxyhydrogen light.—Estimation of phosphates by conversion into phosphides.

A new polarising apparatus has been constructed by M. Hempel, from a suggestion by M. Plucker, the eminent physicist and mathematician of Bonn. The apparatus, which, in the majority of its parts is similar to one already known, is made up as follows:—(1) a black glass, usually horizontal, but capable of being more or less inclined, and upon which the incident ray is polarised rectilineally by reflection; (2) a disc or ring destined to carry and maintain, in the path of the reflected polarised ray, the transparent plate which is to exhibit chromatic polarisation; (3) a convex lens which renders the ray leaving the transparent plate parallel or convergent; (4)—and this is the addition which gives to the instrument a perfection scarcely expected—a parallel glass silvered on the exterior surface, and fixed in a support at such an inclination that it leads to the vertical the doubly reflected and transmitted ray, which it directs to the Nicol's prism, serving as analyser.

Referring again to M. Nicklès' lecture "On the new fluosalts and their uses," noticed last week, your correspondent finds some points of interest that ought not to be omitted. M. Nicklès showed how the various colouring matters used in industry might be detected. For example, commercial substances often owe their colour to "artificial blood;" knowing that sulphocyanides are poisonous, one might wish to be certain whether sulphocyanide of iron had been used in this case. A drop of fluoride of potassium discharges the colour from the iron compound immediately. Similarly, looking at a fabric dyed blue, one might wish to ascertain whether the colour belonged to the anilines, indigo or prussian blue; the two first being unacted upon by the test solution, the fabric would receive a drop of this solution, and then be subjected to a jet of steam. Inks, of course, may be examined in the same way. Those having indigo-carmine for the base, become redder with the fluoride of potassium solution.

In a memoir presented a short time back to the Academy, M. Jeannel remarks "why certain varieties of hydrated sesquioxide of iron dissolve easily in acids, dissolve incompletely, or give unstable salts, is ignored; all that is known is that calcination is an absolute condition of insolubility." He then states that he believes to have found the cause, or at least the most frequent cause of these variations; the hydrated sesquioxide of iron is more or less insoluble in acids, and gives salts more or less unstable, when prepared from substances containing sulphates. Sesquioxide precipitated from the persulphate is always to a certain extent insoluble, or yields unstable salts; the same is the case with the sesquioxide precipitated from the perchloride, when this has been prepared with acids contaminated with sulphuric acid, or equally when the alkalies employed as precipitants have been so contaminated, or, finally, when the ferric hydrate precipitated from pure solutions by pure alkalies has been washed with common water, which chemists need not to be told nearly always contains a little earthy sulphate. Ferric hydrate prepared from materials rigorously free from sulphates, and in vessels rinsed with distilled water, is extremely soluble in the cold in very dilute acids: notably, it dissolves with surprising facility in the officinal solution of perchloride of iron. A new compound, indefinitely soluble, which might be named ferric chloroxide, is easily obtained in solution or in the solid state. This compound is represented by the perchloride of iron, Fe_2Cl_3, and an indeterminate quantity of sesquioxide of iron, Fe_2O_3. M. Jeannel has prepared, in the cold, a stable aqueous solution of ferric chloroxide, which may be represented by the formula $Fe_2Cl_3, 9Fe_2O_3$, and consequently contains nine times as much iron as the neutral or officinal solution. This solution of ferric chloroxide might perhaps be found specially advantageous in checking hæmorrhage. The solution possesses in the highest degree the property of coagulating albumen, and removing albuminoid and colouring matters. A few drops thrown into water produce a very voluminous brown precipitate. The solution of ferric chloroxide is decomposed and precipitated by very small quantities of sulphuric acid, or of sulphates soluble or insoluble. It is likewise decomposed by citric, or tartaric acid, and curiously, or rather surprisingly, it is decomposed by a few drops of concentrated hydrochloric or nitric acids.

The following memoirs of chemical interest were communicated to the Academy on the 21st ult.:—"On the composition of the gaseous mixture used in the oxyhydrogen light, and on a new matter replacing magnesia," by M. Caron; "Estimation of phosphoric acid by the transformation of the phosphates into phosphides of iron," by M. Schlœsing; "Researches on the combustion of oil," by M. Scheurer-Kestner; "Researches on the bleaching of tissues," by M. Kolb; "On the dilation of solid bodies by heat," by M. Fizeau.

The magnesia pencils, made either by compression or by the wet method, cannot, M. Caron says, resist indefinitely the intense heat produced by the combustion of coal-gas mixed with oxygen. It would likewise be difficult to use magnesia with pure hydrogen and oxygen, which give rise to a more intense heat, and consequently greater corrosion. Therefore, he examined other substances. Knowing the infusibility of silicate of zirconium, M. Caron tried this material, but found the light emitted by the pulverised and agglomerated zircon very small, the case with most silicates. There remained the earth zirconia yet. According to Berzelius, this earth is infusible, and emits a brilliant bluish light in the blow-pipe flame. This M. Caron has tried, and to him the earth does not seem volatile in the oxyhydrogen flame. The same pencil used daily for more than a month, heated upon a sharp angle, shows no trace of volatilisation, partial reduction, or loss of any kind. This fact is important, for with a lamp burning only a feeble jet of gas, the part of the flame which gives the light is very small, and the incandescent matter must of necessity always remain at the same distance from the point; as the pencil becomes used, this distance augments, and the light diminishes more and more. M. Caron says, the employment of zirconia seems to him to lead to a notable improvement in the oxyhydrogen light, for besides the valuable quality of remaining intact, zirconia possesses luminous properties even greater than those of magnesia, the proportion being nearly as 6 : 5. Zirconia, it is true, is infinitely rarer than magnesia, but it is found in many volcanic sands, and especially in great abundance in the zirconic rocks, near Miask in the vicinity of Ilmensee, at the foot of the Ural. This rare earth, too, can be easily economised, it need only be employed where the flame impinges, the remainder being magnesia or refractory clay; compression will fasten the two materials together, and baking add to the solidity of the pencils.

M. Schlœsing's memoir deserves a somewhat detailed account. This chemist described in 1864 a process for estimating phosphoric acid, based upon the reduction by carbonic oxide, at a high temperature, of phosphates placed in contact with silica; the phosphorus was collected upon copper or in a solution of nitrate of silver. When the phosphates contain oxide of iron, this process ceases to give exact results. Obliged to accept its presence in manures, vegetables ashes, &c., M. Schlœsing decided to make the iron perform a part in a process. Alkaline and earthy phosphates heated to whiteness in a carbon crucible, with silica and iron, cede to the metal the whole of their phosphorus. This transformation being effected, the phosphorus requires only to be separated from its combination with iron. The task is not as easy as it at first sight appears to be. Acids are not admissible. When dry chlorine passes at a moderately elevated temperature over iron containing phosphorus and some other metalloids, arsenic, sulphur, and silicium, all the bodies are converted into chlorides; this fact is well known. The chloride of iron is less volatile than the others, but not sufficiently so to permit of accurate separation; with the phosphorus, the difficulty is augmented by the formation of a combination between its chloride and the chloride of iron. M. Schlœsing has been enabled to destroy this combination by the use of chloride of potassium, which at the same time greatly lessens the volatility of the chloride of iron. At the temperature at which the experiment is made, the whole of the chloride of phosphorus is disengaged absolutely free from the metallic chloride. The process is minutely described; it will be given in my next letter. Experiments showing the accuracy of the process are appended; in the following figures, the first in each case represents the number required by theory, the second that found—43·74 mg. 45·70; 47·9 mg. 47·5: 3·32 mg. 3·50. Results which testify to the value of the process.

NOTICES OF BOOKS.

The Stock-Feeder's Manual: the Chemistry of Food in relation to the Breeding and Feeding of Live Stock. By Charles A. Cameron, Ph.D., M.D. London and New York: Cassell, Petter and Galpin. 1868.

The basis of this work, we learn from the author's preface, consists of some papers on the Chemistry of Food, read before the Royal Agricultural Society of Ireland and the Athy Farmer's Club, and a few articles on the Management of Live Stock, published in the *Weekly Agricultural Review*. It describes the nature of the food used by the domesticated animals, explains the composition of the animal tissues, and treats generally upon the important function of nutrition. The most recent analyses of all the kinds of food usually consumed by animals of the farm are fully stated; and the nutritive values of those substances are in most instances given. Some information is afforded relative to the breeds and breeding of live stock; and a division of the work is wholly devoted to the consideration of the economic production of *meat*, *milk*, and *butter*. Our readers will see from this brief outline of the contents that Dr. Cameron has produced a book likely to interest a large and increasing class of the community, and a careful perusal of its pages will show that it is one which may be read with interest by the mere consumer of the three staple articles of food above named, as well as studied with profit by the producer.

The author is thoroughly practical in his treatment of the subject. He regards an animal simply as a mechanism by which meat is to be manufactured; and he draws the reader's attention to five economic points:—The first cost of the mechanism, the expense of keeping the mechanism in working order, the price of the raw materials intended for conversion into meat, the value of the meat, and the value of the manure. In proportion to the attention given to these points will be the feeder's profit.

The chemistry of food, and the value of different kinds of meat are gone into very fully. The evils resulting from over-fattened, over-driven, or positively diseased meat, are discussed at length; and here Dr. Cameron, in his capacity of analyst to the City of Dublin, is able to speak from his own experience to the large amount of meat, unfit for human food, which is brought to our large markets; 30,000 lbs. weight of bad meat being the probable quantity offered for sale in London alone every week, 2,000 lbs. of which are condemned by Dr. Letheby in the limits of his jurisdiction.

CORRESPONDENCE.

SCIENCE TEACHING IN SCHOOLS.

To the Editor of the Chemical News.

Sir,—The remarks that have lately appeared in the pages of the Chemical News, by Messrs. Rodwell, Johnson, Oscar Browning, Tomlinson, and Bloxam, on the subject of science teaching in schools, will have been read with interest by many who, like myself, are engaged in this important work. As I believe that few things are more likely to lead to the formation of definite opinions as to the possibilities and impossibilities of the various schemes that have been suggested, than a comparison of notes and interchange of ideas amongst those who are so engaged, I propose to say a few words on some of the statements advanced by the writers referred to, and then to give, very briefly, an outline of what we are doing at Rugby, stating some of the results at which we have arrived.

In the first place, then, I fully agree with Mr. Tomlinson's remark, that boys are good observers, but bad theorists. I believe that it is essential to success to realise this. And it is those alone who have had considerable experience with boys who seem able to do so. My own experience extends now over fourteen years, and the last few years have more than ever convinced me of the necessity of admitting this as an established fact. Holding this view, I cannot but think that the prominence Mr. Rodwell assigns to theory in chemistry would be fatal to success with the majority of boys. Of course with senior and advanced pupils we may go as far into theory as we like, and in a large school there will probably be some who are quite fit for reading of this kind: but I am speaking of lecturing on chemistry to classes composed of ordinary schoolboys, with no special aptitude for the subject. Mr. Rodwell asserts "that to thoroughly master the vibratory motion theory, as applied to the explanation of chemical phenomena, is better, as a mental exercise, than the knowledge of fifty of the applications of chemistry;" and he goes on to say that "science applied to the useful arts—to the making of dyes, the extraction of metals, the manufacture of coal gas—has ceased to be pure science." I fully and entirely agree with Mr. Rodwell that chemistry is not to be taught to boys *because* it admits of such applications, and so has a kind of money value; but, at the same time, I can only say that, in lecturing on aluminium, for instance, I should be sorry to lose the additional interest that I always find given to the subject by showing, and that experimentally, the application of the peculiar properties of alumina to the processes of dyeing and calico printing. And so again with regard to coal gas and the coal-tar colours, as a sequel to a lecture on carbon. I have not the slightest sympathy with so-called popular science. I believe science to be quite as hard as Latin and Greek, and to require at least as great an exercise of the mental powers to master it. But for all this, I do not see why the more important practical applications of science are to be thought unworthy of a place in the lecture-room.

Next, with regard to method of teaching. Mr. Johnson suggests that, as a lecturer on science can hardly be expected to undertake the drudgery of drilling his boys in elementary notions, meaning of terms, &c., his lectures should be supplemented by another master, who would be contented "to go over the ground again, and pick out the weeds that the lecturer had left behind." Without saying anything of the improbability of finding many men competent and willing to do this not over exciting work, surely it ought, in itself, to be unnecessary. No lecturer ought to get on faster than his pupils can follow him, and he can only ascertain this by constant oral questionings during the lecture, followed if need be, by repetition and additional explanation of what has been said before. This, it seems to me, is just the difference between a popular lecture in a town-hall, and a scientific lesson in a school-room. Of course the rate of progress through the subject will be slow, but anyhow it will be sure. And I am convinced that, with regard to science, it is better to teach even a very small amount thoroughly well, than to get over a much larger extent of ground superficially. Mr. Johnson says, "we who live with boys, and become or remain like boys, know better than the lecturer knows their shoals and fogs of misconception, their power of forgetting, &c., &c."; but this is assuming that the lecturer is not one of the regular resident masters, and so long as this is the case, he certainly would be at a distinct disadvantage. Mr. Oscar Browning, indeed, proposes that scientific information, as distinguished from scientific training, should, as a rule, be taught by such itinerant lecturers. As a first step towards introducing the study of science into a school, this would be all very well, and no doubt it would give a kind of impulse, and awaken interest and aptitude in particular boys. But I should be sorry to see the scientific teaching of a school entrusted to any but regular resident masters.

There is another point in Mr. Browning's paper that, I think, calls for some observations. Mr. Browning urges the introduction of applied mathematics in the form of statics, dynamics, and hydrostatics into schools, and he "sees no reason why these subjects should not be obligatory upon all the scholars." Now I cannot believe that the mass of boys in any public school are sufficiently advanced in mathematics to be able to take up such subjects as these, treated *mathematically*. For those who are sufficiently advanced these studies would be excellent; but I understand Mr. Browning to advocate their general introduction as the staple of the scientific work of the school, chemistry and other branches of science being only taught in exceptional cases.

I can only say that my experience goes to prove that the majority of boys in a public school find quite sufficient difficulties in following a course of lectures on elementary mechanics, including little more than the mechanical powers and the simpler forms of mechanism, treated graphically and arithmetically, not *mathematically*.

I believe that mechanics, hydrostatics, and pneumatics, treated experimentally, with such explanations as involve little more than general reasoning, are exceedingly valuable subjects for school work, and might well form a part in any complete scheme of scientific instruction, but their mathematical treatment must, I feel sure, be reserved for the more advanced pupils.

I will now say a few words with regard to our work at Rugby. The school is divided into:—the lower school, containing 50 boys; the middle school, consisting of two divisions, upper and lower, with a total of about 270 boys; the upper school, with 135; and the highest, or sixth form, with about 45. The average age of the boys in the lower school may be said to be 14; in the two divisions of the middle school, 15 and 16; in the upper school, 17; and in the sixth form, 18.

In the lower school natural science is not taught at all. In the middle school every boy learns some branch of it: and in the upper school and sixth form the boys are allowed to choose between natural science and German, the result being a pretty equal division of the two subjects. In the lower middles the subjects are botany, physical geography, and very elementary mechanics. In the upper middles, the botanical work is continued, physical geography is supplemented by geology, and a higher course of mechanics and mechanism is commenced. In the upper school geology and chemistry are, at present, the only subjects taught, and in the sixth form chemistry alternates with some branch of experimental physics. The work is shared between five masters, who give two lessons a week (of one hour each) to each "set." Rough notes are taken by the boys during the lecture. These are afterwards elaborated into note-books which are shown up to the master at regular intervals; they are looked over and corrected by him, and then returned.

Of the success of the botanical work, as a commencing subject, we have not a doubt. It has proved itself to be quite within the grasp of the younger boys. They do it exceedingly well, and are greatly interested in it. They gain from it ideas of terminology, classification, and generalisation, that prove of real value to them in their subsequent progress.

The mechanical work is more difficult; but many boys have a natural bent in that direction, and those who are fair mathematicians frequently enter into it with ardour. Indeed, there are certain portions of the subject that I have always found to greatly interest the whole class. I refer to the application of mechanical principles to roofs, bridges, buttresses, and the theory of construction in general.

Geology, again, is a subject in which many boys take a real interest. But to study geology satisfactorily implies a larger stock of preliminary knowledge of chemistry, mineralogy, and natural history, than most boys can bring to the task. For this reason, geology is, perhaps, hardly quite satisfactory as a study for schoolboys.

With regard to chemistry I have one or two things to say. There is some uncertainty as to what is generally meant by *teaching* chemistry. In most cases, I believe, it means simply delivering lectures on the metallic or non-metallic elements, with more or less of experimental illustration.

Of course a good deal of information may be given in this way; but I have a strong opinion that this is not sufficient to make chemistry a really effective instrument in a school. I believe that the boys must work and experiment for themselves in order to make the knowledge their own. The most satisfactory results would, I cannot but think, be obtained by making the lessons alternately oral and practical—the teacher explaining at one lecture certain principles and processes, and the boys themselves at the next attempting to carry these out experimentally in the laboratory, of course with sufficient assistance and supervision. Professors Eliot and Storer (whose book I find most valuable as an experimental guide with my own pupils) tell me that this is the plan they adopt in America with very large classes, and they speak with enthusiasm of the gratifying results. Our laboratory at Rugby is too small to enable us to carry out this plan fully at present, but a larger laboratory is about to be built, and then we shall give it a fair trial.

There are many boys, however, who go through what is called a course of chemistry at school without ever touching practical analysis, and yet I believe that this is, educationally speaking, the most valuable part of the subject.

I have for years entertained a strong opinion of the benefits to be derived from the study and practice of chemical analysis, simply as a scientific training, independently altogether of any utility in the knowledge obtained. It has always appeared to me to be almost perfect in the variety of mental faculties which it calls into exercise, and in the example it affords of method in the investigation of truth. All this is shown with great force by Professor Williamson in the second number of *The London Student*, and, so far as I am aware, it is the first time that the peculiar claims of this branch of chemistry, in an educational point of view, have been insisted on. I have daily opportunities of watching the interest that many quite young boys take in working out their analyses in our laboratory, and I have often felt convinced that in no part of their school work are their minds more thoroughly in a state of real activity than when so engaged.

I fear that I have already taken up too much of your space, and therefore forbear to go more into detail. I will only remark, in conclusion, that we by no means regard our natural science arrangements at Rugby as complete, since we are greatly hampered for want of more accommodation in the way of lecture rooms, &c. As soon as our new buildings are erected we shall introduce much more of experimental science. Elementary hydrostatics and pneumatics will then probably take the place of geology in the middle school, and electricity and heat will form part of the regular work of the upper school and sixth form.—I am, &c.,

T. N. Hutchinson, M.A., F.C.S.

Rugby, June, 1868.

MISCELLANEOUS.

Disinfectants at Terling.—*The British Medical Journal* gives the substance of an official report by Dr. R. M. Glover, Medical Officer of the Millbank prison, who was sent down to Terling by the Home Secretary to superintend the application of disinfection by carbolic acid on an extensive scale during the recent epidemic. Dr. Glover says:—My instructions were to assist in the endeavour to arrest the epidemic of intestinal or typhoid fever prevailing in that village, by means of carbolic acid. I was desired to take with me a supply of carbolic acid for immediate use; to superintend its application in the first instance; and to give every information to the local authorities as to its use and management. I now beg to state briefly the means to which I had recourse for carrying out these instructions, and the apparent effect of the use of carbolic acid in arresting the spread of the fever. On Monday, February 17th, with the concurrence of the local authorities, I caused a strong solution of Calvert's carbolic acid to be distributed over the entire village. Large quantities of the solution were poured into the cesspools; and it was freely applied to the filthy yards, courts, and stagnant ditches by which many of the houses were surrounded, as well as to the manure heaps, collections of refuse, and other nuisances with which the place abounded. The village may be said to have been soaked with the acid, and the atmosphere became highly charged with its vapour, which found its way, in very considerable volumes, into the dwellings of the sick and healthy alike. This process has been daily repeated up to the present time; and I have advised the local authorities to continue the use of carbolic acid during the ensuing spring and summer months. Many of the inhabitants at first fancied that the smell of the acid produced headache, and for a few days the inspector of nuisances, who was employed in its distribution, was the most unpopular person in Terling. This objection, however, has been overcome; and at my second visit on the 18th instant, no complaints were made, although the presence of carbolic vapour in the atmosphere was to be detected at a considerable distance from the village. The epidemic prevailing at Terling was the common intestinal or typhoid fever, a preventable disease, which kills annually no less than 20,000 of the population of this country. Out of a population of 900 persons, about 300 have been attacked with intestinal fever since the 4th December, and of this number 41 have died. With the exception of a lull of a few days in the third week of February, fresh cases continued to occur almost daily up to the end of the month, while only two persons have been attacked since the 1st of March. The carbolic acid was first extensively used, as already stated, on the 17th February; and, allowing ten days for the expiration of the period of incubation, or period of latency, there can be no question that the subsidence of the epidemic corresponds, in point of time, with the date at which the purifying influence of carbolic acid might antecedently have been expected to become manifest. That incredible quantities of fœcal matters had accumulated in uncovered cesspools, open ditches, &c., and had soaked into the soil, admits of no doubt; and there can be as little doubt that the decomposition, or, in the language of chemists, the putrefactive fermentation of these matters, was the essential cause of the fever. The special and characteristic chemical property of carbolic acid is the peculiar power which it possesses of arresting putrefactive changes; and it therefore appears to me reasonable to conclude that the extensive use of carbolic acid and the simultaneous disappearance of the disease, are facts which hold the relation of cause and effect. It will not, I believe, be disputed that our knowledge of the causation of fever points to carbolic acid as being the most powerful agent which can be used for the destruction of that specific poison, which, being absorbed into the human organism, sets up the succession of phenomena known as typhoid fever; and it is to be regretted, therefore, that it was not brought into use at an earlier stage of the epidemic. But, however powerful may have been the action of carbolic acid at Terling, its use as a disinfectant can only be looked upon as a temporary expedient for holding pestilence in check until the contemplated and much needed sanitary improvements have been carried into effect.

Discovery of Rock Salt at Dax.—A mine of rock salt, situated in the Department of the Landes, close to the town of Dax, has been conceded by the Imperial Government of France, and a Company has been formed to carry out the concession by the establishment of salt and alkali works. Its existence was discovered in a singular way. A poor man remarking the profits made by many of his neighbours in working some of the numerous hot springs so abundant in the town of Dax, determined to bore in his garden near the ramparts of the town, in search of hot water. Having pierced about 100 feet through sand and clay, alternating with beds of gypsum, he suddenly struck a hard resistant mass, in which he broke off the end of the boring tool; after numerous and fruitless efforts he succeeded in at length recovering the broken bit, and with it brought up a fragment of rock which proved to be nothing more or less than salt. After this discovery he wisely determined to change the plan of his operations, and to try and bore through the salt with water. With this view a pipe was passed down the soil pipe as far as the salt, and a second and smaller pipe was placed within it. The ends of both the pipes were allowed to rest on the salt, and fresh water being poured down the interval between the two pipes, salt water—resulting from the solution of the salt—was pumped up from the inner pipe. Thus by this process of solution the bed of salt was pierced through to a thickness of no less than 50 feet. This layer was subsequently found to overlie a second one, being only separated from it by a thin layer of saliferous clay. A fresh boring has been executed at about one mile from the first, where several layers of rock salt have been pierced, of a total thickness of 131 feet. The average composition of the salt in its rough state shows that it contains 97⅛ per cent of pure salt. Mr. Maxwell Lyte has prepared a report of this discovery, in which he says that it would be difficult to find a spot more favourably situated for the establishment of salt works than that in which Dax lies. Besides the salt in question the neighbourhood contains mineral deposits of much collateral interest and value. Lignite is found in large quantities; and both French and English coals can be delivered at a very low price, so that there is every reason to believe that this commercial enterprise will be at once lucrative and important.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Comptes Rendus.

February 17, 1868.

I. Pierre and E. Puchot. "Experimental Researches on the Products of the Distillation of Beet-root." A. Houzeau, "On Peroxide of Hydrogen considered as not being the Cause of the Changes produced in Litmus Paper impregnated with a Solution of Iodide of

Potassium when used as a Test for Ozone in the Atmosphere." Rakowitsch, "On the Use of Chloroform for the Qualitative and Quantitative Examination of Rye Flour and Alcoholic Liquors."

February 24.

A. Mallett, "A Method of Manufacturing Chlorine and Oxygen from Protochloride of Copper." Blondlot, "On the Production of Ozone and Phosphoric Acid during the Slow Combustion of Phosphorus." Le Ricque de Monchy, "On a Ferment discovered in commercial Bicarbonate of Soda." Martin, "A Method of Preserving Meat by means of Sulphuric Ether."

Annales de Chemie et de Physique.

January, 1868.

C. Marignac, "On the Separation of Niobic Acid from Titanic Acid, and on an Analysis of Æschynite." R. Radau, "On the Static Barometer." Schonbein, "On the Presence of Ozone in the Atmosphere." F. Rossetti, "On the Use of the Thermo-electric Pile for Measuring the Temperature of the Body." A. Barthelemy, "On the Estimation of Carbonic Acid in Bicarbonates and Waters by means of Protonitrate of Mercury." Musculus, "On the Hydrates of Stannic Acid." A. Bechamp, "On the Action of Chalk and the Living Organisms which it contains in Butyrous and Lactous Fermentations."

Bulletin de la Société Industrielle de Mulhouse.

January, 1868.

Coupier, "On the Red Colouring Matters derived from Toluene." C. Kœchlin, "On Pernod's Process for Detecting Adulterations in Garancine and its Derivatives." G. Schæffer, "On the same Subject." E. Dollfus, "On Thirault's Safranine, a new Yellow Colouring Matter." G. Schæffer, "On Meister, Lucius, and Co.'s new Aniline Green." Coupier, "On the Author's Claim to the Invention of Toluidine and Cumidine Red." Thirault, "On Safranine Red and Safranine Yellow and on Mureine Grey." O. Scheurer, "On the Author's Claim to the Invention of a Method of extracting Red, Pink, and Violet Colouring Matters from Garaneine." Pernoo, "A Method of producing the Shades of Colour between Black and Violet and Red and Pink from an Extract of Garancine." A. Dollfus, "On E. Hofer-Grosjean's New Fusible Alloy of Lead, Tin, and Cadmium." M. Ziegler, "On the Presence of Aniline in the Coloured Fluid ejected by the Sea Hare, *Aplysia depilans.*" E. Dollfus, "On Thirault's Safranine Yellow." J. Meyer, "On the same Subject." Thomas, "On a new Colouring Matter extracted from *Sericographis mohitli.*" Rosenstiehl, "Report on M. Ziegler's Memoir on the Presence of Aniline in the Coloured Fluid ejected by the Sea Hare, *Aplysia depilans.*" Hopp, "On an Extract of Horse Flesh." J. Lefort, "On Buckthorn Seeds from a Chemical and from an Industrial Point of View." C. O'Neill, "On the Causes of the Explosion of a Boiler used for preparing Resin Soap." Rosenstiehl, "Researches on the Composition of Toluene Red." "Reboulleau, "On the Growth of Garancine in Algeria." Kuhlmann, "On the Action of Water on Lead." Asselin, "On a Process for Refining Vegetable Oils by means of Caustic Soda." J. Roth, "On the same Subject." Gerber-Keller, "Remarks on Kuhlmann's Essay on the Action of Water on Lead." Kuhlmann, "Answer to the preceding Remarks." G. Schaeffer, "On the History of the Application of Extracts of Garancine as Colouring Matters for Printing Fabrics." Rosenstiehl, "Report on Asselin's Process for Refining Vegetable Oils by means of Caustic Soda. Report on the Methods used at Dieuze for utilising Chlorine Residues and Soda Waste."

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1082. A. B. Walker, Warrington, Lancashire, "Improvements in the application of hot blast or heated air for evaporating salt, brine, and other liquids, sugar, or chemicals, also for heating gas and oil retorts, raising steam in boilers, boiling worts in breweries and distilleries, which improvements are also applicable for bleaching, tanning, and baking, likewise improvements in apparatus used in some of the aforesaid applications."—March 30, 1868.

1086. W. Austin, Greville Street, Hatton Garden, Middlesex, "Improvements in the composition, boxes, and surfaces for obtaining instantaneous light from chemically prepared matches intended to be ignited by friction."

1095. H. Bessemer, Queen Street Place, Cannon Street, London, "Improvements in the manufacture of malleable iron and steel, in the heating and melting of metals, and in the machinery or apparatus employed for such purposes."—March 31, 1868.

1102. W. Smith, Glasgow, N.B., "Improvements in the manfacture of pig iron."—April 1, 1868.

1117. J. G. Dale, and E. Milner, Warrington, Lancashire, "An improved method of producing white pigments from lead."—April 2, 1868.

1124. C. D. Abel, Southampton Buildings, Chancery Lane, "A new or improved process and apparatus for refining camphor."—A communication from C. E. Perret, Boulevard de Strasbourg, Paris.

1126. J. M'Culloch, Shawlands, Renfrewshire, N.B., "Improvements in utilising old or waste tarpaulin in the manufacture of grease and other useful products, and in apparatus therefor."

1130. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of cast steel and malleable iron from cast iron, and in the apparatus or means employed therein."—A communication from F. Ellershausen, Ottawa, Canada.—April 3, 1868.

NOTES AND QUERIES.

Vessel for holding Nitric Acid.—"R. C. M." is desirous of information concerning a vessel to hold about 193 cubic feet = 1,200 gallons of liquid made up of 1-20th of strong nitric acid and 19-20th of water, and to boil this mixture by the aid of steam applied inside, which of course implies that steam from a boiler is brought by means of a pipe ending in the liquid with open orifices. "R. C. M." might make the tank of slate; slabs of this material can be had of any size, and, if properly selected, will answer his purpose admirably; the slabs will of course have to be grooved into each other, and the grooves run tight with a resinous cement. As to the material of the steam pipe "R. C. M." should recollect that neither lead, copper, iron, or tin can in his case serve the purpose, and he would do best perhaps to procure for the inside of the vessel as steam pipe, a tube made of hard pottery ware perforated with small holes; such tube any of the Lambeth potteries, or the works of the Staffordshire pottery district, would make him to order. I suppose "R. C. M." knows that the condensation of steam in the cold fluid will tend to dilute the acid of the mixture, and also to increase the bulk of the fluid inside the tank, the capacity of which should not be less than 200 cubic feet; a tank 10 feet long, 5 feet wide, and 4 feet deep will answer the requirements, inside measurement.—Dr. A. A.

Aniline Green.—Cathartic Acid.—I reply to "Test-tube," concerning aniline green and cathartic acid, the following:—I am not aware that there exists any iodine green; perhaps "Test-tube" may try picric acid, also called carbazotic acid, and indigo solution, as "Test-tube" must be aware that nearly all green dyes are made up from the mixtures of yellow and blue dyes. A genuine green, known as Chinese green, or Lo-kao, is obtained in China from *Rhamnus chlorophorus* and *utilis*; the berries of *Rhamnus catharticus*, a plant met with in Southern Europe, yields the sap-green. "Test-tube" is mistaken as to his notion on senna leaves; the tree which yields these has nothing at all in common with the plant just alluded to, neither has cathartic acid with either the purgative properties of senna or the dye value of divers varieties of the *Rhamnaceæ*. Lo-kao is, at least in France, a regular article of trade, and pretty extensively used at Lyons, Nismes, Rouen, and other centres of textile fabrics and dyeing industry of France.—X.

Cast Porcelain.—Can any one tell me what this material is? It is being manufactured in America on a somewhat large scale, and from some specimens which I have seen, it must be a very beautiful substance. Is it ordinary glass devitrified?—Silex.

Sulphide of Magnesium.—Can any one furnish me with a practical recipe for the production of MgS?—W. W.

Dead Oil.—A correspondent wishes to know where this can be obtained.

TO CORRESPONDENTS.

Qui Color.—The best book on the subject, with which we are acquainted, is O'Neill's Dictionary of Dyeing and Calico Printing, published by Ireland & Co., Manchester. Messrs. Longmans & Co. have a work on the aniline dyes just ready for publication.

R. E. B.—An Old Subscriber.—Some little time must unavoidably elapse between the delivery and the publication of a lecture, when, as in the instances you refer to, the author himself rewrites the lecture specially for our columns. We imagine that the readers of the Chemical News prefer to wait for a week or two when the advantages to be gained are so great. In scientific lectures a mere shorthand report is not sufficient without the authors' corrections.

Z. Z.—For the processes required for the valuation of manganese see the fourth edition of "Fresenius's quantitative analysis," published by Churchill, page 618.

Communications have been received from W. Woodbury; J. Samuelson; W. White (with enclosure); D. Forbes; A. de Lomonossoff; W. H. James (with enclosure); F. O. Ward; J. N. Vinen; R. E. Bibby; R. Ruding; Rev. T. N. Hutchinson (with enclosure); Dr. B. H. Paul (with enclosure); E. Yewdale; J. Storey & Co.; Dr. J. Blyth (with enclosure); J. S. Brazier (with enclosure); Thos. Taylor (with enclosure); P. Squire; F. Kitchin; D. Penney, P. J. Worsley (with enclosure); the London Stereoscopic Company, Archibald, Walker, and Co. (with enclosure); J. Young; M. Monier (with enclosure); J. Heywood.

MEETINGS FOR THE WEEK.

Wednesday.—Meteorological, 7.
—— Geological, 8.
Thursday.—Royal Institution, 3. Sir John Lubbock, Bart., "On Savages."
—— Royal, 8½.
—— Chemical, 8. Professor Wanklyn, "On the Establishment of High Chemical Formulæ." Professor Church, "On some Cornish Minerals."
—— Philosophical Club, 6.
Saturday.—Royal Institution, 3. Sir John Lubbock, Bart., "On Savages."

THE CHEMICAL NEWS.

Vol. XVII. No. 446.

ON THE
ESTIMATION OF SULPHUR IN MINERALS CONTAINING IRON.

By M. W. EGGERTZ,
Professor in the Fahlun School of Mines.

Five grammes of the mineral, ground as finely as possible in an agate mortar, are treated with chlorate of potash and hydrochloric acid in the same manner as in the case of iron. After desiccation and the employment of hydrochloric acid and water, the insoluble substances may be sulphates of lead, lime, baryta, strontia, silicic acid, and undecomposed mineral. By stirring well and filtering the liquid whilst warm the two former salts likewise may generally, however, be dissolved.

The filtration should be performed through strong paper, or rather through a double filter, to prevent the pulverised mineral from passing through. When the clear portion of the solution has been poured upon the filter, add to the insoluble matter 5 c.c. of hydrochloric acid and 5 c.c. of water; then leave the mixture for two hours on the water-bath at a boiling temperature, and, if care be taken to stir well, the sulphate of lime will be completely dissolved. Wash the insoluble portion in warm water, and pour it on a filter, taking care to place below a flask specially to receive that portion of mineral which may have passed through the filter. The precipitation of the sulphuric acid is effected as already described.* After adding chloride of barium and cooling the solution, add 10 c.c. of ammonia.

To dissolve the sulphate of lead, which may occur in the insoluble portion, remove this from the filter with the end of a feather, introduce it into a flask, and pour over it 10 c.c. of concentrated acetate of ammonia. The solution after having been strongly agitated and heated in the water-bath, is carefully poured on to a filter. Then wash the residue with a little acetate of ammonia, and repeat the treatment until a few c.c. of solution, acidulated with a little acetic or hydrochloric acid, is not rendered turbid when warmed with chloride of barium solution. The filtrate is then diluted, slightly acidified, and the sulphuric acid precipitated by means of chloride of barium. After the sulphate of lead has been removed, there may still occur sulphates of baryta and strontia in the insoluble portion, although these have not hitherto been met with in the iron ores of Sweden. To decompose these salts the residues must be dried, heated to redness, and weighed, and then fused with five times their weight of pure dry soda. The mass is digested with water over a water-bath, the liquid filtered, and the residue washed with warm water. The silicic acid is separated from the solution, which contains the silicate, the carbonate, and the sulphate of soda, by adding hydrochloric acid and drying on the water-bath. After filtering, precipitate the solution with chloride of barium.

To ascertain if the iron mineral contains gypsum or other soluble sulphates: take 5 grammes, place them in 20 c.c. of hydrochloric acid and 60 c.c. of distilled water, and digest them for three hours on the water-bath, with frequent agitation. The filtered solution is mixed with chloride of barium and 15 c.c. of ammonia; then proceed as already described. If there are found in the mineral grains of iron or copper pyrites, or galena, their presence will only give in this operation traces of sulphuric acid.

To ascertain the accuracy of the process which has just been described, the following experiments have been made:—

I. A sulphide of iron (as usually employed in the preparation of sulphuretted hydrogen) was dissolved in the manner above described, in hydrochloric acid, water and chlorate of potash, in a flask furnished with a glass tube leading into a solution of sulphate of copper. No trace of precipitate, nor any colouration which would indicate the presence of sulphide of copper, could be detected in the solution; so that it is certain that no loss of sulphur could take place on dissolving iron or minerals in this manner.

When the experiment was repeated, but with this alteration, that the solution of chlorate of potash, during the addition of hydrochloric acid, was not kept well boiling, the sulphate of copper solution was rendered turbid, showing the necessity of resorting to complete ebullition.

II. The sulphide of iron treated in the same apparatus with aqua regia (composed of equal parts of nitric and hydrochloric acids) requires a more equal temperature and a stronger ebullition to prevent any precipitation of copper. Moreover, as the solution of iron by chlorate of potash takes place promptly, and as the presence of nitric acid is prejudicial both for the solution of the mass after drying in the water-bath (owing to the formation of subnitrate of iron), and also for the precipitation of the solution by chloride of barium, preference should be given to the employment of chlorate of potash.

III. One gramme of pure pyrites was treated in the above described manner, and the sulphur which separated at first was completely dissolved during the drying of the liquid on the water-bath. Upon precipitating with chloride of barium, a quantity of sulphate of baryta was obtained, exactly corresponding to the amount of sulphur in the pyrites.

IV. Many experiments were made with the filtered liquids obtained from solutions of iron which had been freed from sulphur by excess of chloride of barium. After standing for several days these have been brought to ebullition and mixed with 1 c.c. of an aqueous solution of sulphate of soda, containing a quantity of sulphuric acid, corresponding to 0·0001 gramme of sulphur. At the end of at least 24 hours a feeble precipitate is observed, which proves that the sulphuric acid is perfectly separated from the iron. This precipitate is rendered distinctly visible when the contents of the flask are stirred by moving a glass rod circularly round the liquid, for the sulphate of baryta then mounts in a small whirlpool and falls again on to one spot. When, also, 50 c.c. of the solution of sulphate of soda are added to the filtered liquids, the exact weight of sulphate of baryta has been obtained. If, in the filtered liquids, there were 10 c.c. of free hydrochloric instead of 5, two days sometimes elapse before the precipitate from the solution (containing 1 c.c. of the sulphate of soda solution) becomes visible. Consequently if there are more than 5 c.c. of free hydrochloric acid in the solution, there must be added for each c.c. in excess (to the solution augmented by chloride of barium and then cooled) 1 c.c. of caustic ammonia, weighing 0·95 gramme, and the hydrochloric acid will be in this way nearly neutralised. The precipitation takes place more easily than when the iron solution is used, if 1 c.c. of the aqueous solution of sulphate of soda is added to a mixture of 150 c.c. of water and 5 c.c of hydrochloric acid; this shows that the solution of the iron mineral renders the precipitation more difficult.

V. In many experiments in which the sulphate of baryta was washed for a long time on a filter, both with warm and cold water, it was impossible, upon evaporating a drop of the filtrate on a watch glass, to avoid traces being left on the latter. Some drops of a solution of chloride of barium and a little hydrochloric acid having been added to the filtrate always produced a feeble white precipitate by the action of heat. For this reason the washing should only be continued until a drop of the washing water leaves on evaporation on glass an almost interceptible white ring.

VI. 4·9 grammes of carbonate of lime, and 0·1 gramme of pyrites submitted to the same process of solution gave by evaporation on the water-bath a perfectly clear solution; after drying, 6 c.c. of hydrochloric acid, and 50 c.c. of water were added to the residue, and there was thus obtained a considerable mass of gypsum. On leaving the liquid for an hour on the water-bath and increasing the quantity of water, the gypsum was completely dissolved.

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* See Chemical News, this Volume, No. 439, p. 207.

0·1 gramme of gypsum was dissolved in 2 c.c. of hydrochloric acid and 4 or 6 c.c. of water (or better still in 10 c.c of acetate of ammonia). The solution was left for half an hour on the water-bath with frequent agitation. It could then be diluted with water, at pleasure, without the gypsum being precipitated.

VII. 0·5 gramme of sulphide of lead (galena) were completely dissolved in the same manner, and the solution brought to dryness on the water-bath. A little water was added to remove the chloride of potassium, and evaporated after solution of this salt; the sulphate of lead which remained was then completely dissolved in 20 c.c. of acetate of ammonia, and precipitated with acetate of baryta containing a little free acetic acid. The sulphate of baryta, which was of the proper weight, was of a grey colour, but became whiter without alteration of weight by being heated to bright redness for some time with access of air.

0·1 gramme of sulphate of lead dissolves without rise of temperature in 2 c.c. of acetate of ammonia; chloride of lead dissolves in it still more easily. The solution may be diluted with water without any precipitation taking place.

0·1 gramme of sulphate of lead was dissolved on the water-bath by violent agitation for half an hour with 4 c.c. of hydrochloric acid (of 1·12 sp. gr.) diluted with 2 c.c. of water; but the sulphate commenced to crystallise as soon as the liquid was cooled to 60° or 70°.

VIII. 4·7 grammes of an iron mixture containing a known quantity of sulphur having been mixed with 0·1 gramme of pyrites, 0·1 gramme of sulphide of lead, and 0·1 gramme of gypsum, treated in the same manner as the iron mineral, gave exactly the quantity of sulphate of baryta which it should have yielded by theory. The precipitate from the solution in acetate of ammonia only weighed a few milligrammes.

IX. An aqueous solution of sulphate of soda, accurately standardised, and then chloride of barium, were added to a solution of soluble glass acidulated with hydrochloric acid. The weight of the sulphate of baryta which was formed showed that the gelatinous silicic acid in solution in the acid does not interfere in these experiments.

X. 0·1 gramme of pure quartz was fused with 0·5 gramme of anhydrous soda in a platinum crucible. The mass was completely soluble, without heating, in 5 c.c of water, and the liquid remained clear even in the water-bath.

XI. 0·1 gramme of sulphate of baryta was fused in a platinum crucible with 0·5 gramme of carbonate of soda; the mass, treated with water, was poured upon a filter and washed. The carbonate of baryta remaining on the filter was brought to a red heat, and then dissolved in dilute hydrochloric acid without the least residue. The same experiment was tried with sulphate of strontia. It follows, therefore, that these two salts may be completely decomposed by fusion with carbonate of soda.—*Moniteur Scientifique.*

ON THE

ESTIMATION OF SULPHUR IN COAL GAS.[*]

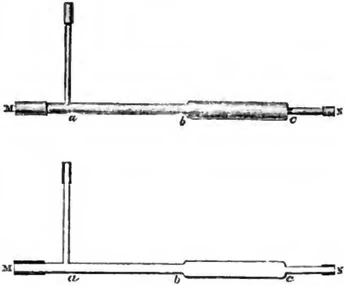
By WM. VALENTIN, Esq.,
Principal Assistant in the Royal College of Chemistry.

In an article "On a New Method for Estimating Sulphur in Coal Gas," published in the *Journal of Gas Lighting* of January 7, 1868, I drew the attention of gas engineers to the defects of the method now generally in use for estimating the sulphur in gas. I stated that at some future time I would submit the two methods—viz., that described by me, which, for shortness sake, I will call the *platinum process*, and the *lime* (soda-lime) *process*, to some further comparative experiments.

Since writing these lines I have had occasion to make a series of experiments on the estimation of sulphur, both in the form of volatile sulphur compounds and that of sulphates contained in grains, such as wheat, peas, beans, &c., and have for this purpose combined the two methods of combustion—viz., over spongy platinum and over pure soda-lime perfectly free from sulphuric acid. To effect this I employed a tube made of thin platinum, in which the combustion of the volatile sulphur compounds was accomplished by passing them over spongy platinum, and then over a layer of soda-lime. The air which was required to burn the volatile organic matter was supplied through a narrow platinum tube, which branched off from the main tube a little way anterior to where the layer of spongy platinum was placed. An aspirator drew the required amount of air through the tube, and by means of an adapter-tube and flask containing some solution of *pure* caustic soda, any sulphuric acid could be arrested that might possibly escape the absorptive and fixing action of the caustic alkalies placed in the platinum tube. After a number of most carefully conducted experiments, I satisfied myself that not a trace of sulphuric acid escaped from the platinum tube, and that, in fact, my precaution of having a solution of a powerful absorbing agent in front was superfluous. *Soda-lime absorbs and arrests every trace of sulphuric acid.* Acting upon this observation, I at once adopted the same mode of proceeding for the estimation of the sulphur in coal gas. Thus, instead of carrying on a series of comparative experiments in order to establish the claims of the lime process over the platinum process—the so-called Letheby process, I believe, may be left out of consideration altogether, after the evidence that has been brought forward by various investigators, showing its utter worthlessness as a process for accurately estimating the sulphur in coal gas—I resolved upon combining the advantages of perfect and easy combustion possessed by the platinum process with those for complete absorption of the sulphuric acid held out by the soda-lime process.

To this end I employed a platinum tube,[*] MN, Fig. 1 (¼ size), 13 inches in length, which could be heated on a small Hofmann's combustion furnace, in the place of the porcelain tube described in a former article. The portion of the platinum tube marked *a b*, 5 inches in length and three-eighths of an inch in diameter, is charged

FIG 1.



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[*] Reprinted, by permission, from the *Journal of Gas Lighting.*

[*] I am indebted to my friend Mr. E. Matthey, of the firm of Messrs. Johnson and Matthey, of Hatton Garden, for a platinum apparatus of admirable make and great neatness.

with a cage constructed of a double roll of fine platinum gauze and filled with spongy platinum. The wider portion of the tube, *b c*, 4 inches in length and five-eighths of an inch in diameter, contains the soda lime. The air requisite to completely burn the gas enters through a narrow glass tube, connected by means of a small cork at M with the wide end of the platinum tube. A cap of an alloy of silver and copper soldered to this part of the tube strengthens it sufficiently to prevent the thin platinum from being injured by a tightly fitting cork. The supply of gas to the tube passes through the narrow tube four inches long and three-sixteenths of an inch in diameter, likewise capped, which is seen to branch off at a right angle from the portion of the main tube next to the anterior part of the platinum cage containing the spongy platinum. The products of combustion are allowed to escape at N, through the narrow platinum tube *c* N. Connections for supplying gas and air are made by narrow non-vulcanised black india-rubber tubing.

I find it most convenient to supply the air under slight pressure by means of a gasholder, from which the air is expelled by displacement with water. Such gasholders are found in most gas-works. A Low's motive-power meter may also be employed with great advantage, as it is capable of being regulated so as to give a supply of air sufficient for one experiment, whilst a small gasholder would require to be refilled with air once or twice during an experiment. The pressure from the gas-mains is at all times sufficient to send the gas through the platinum tube. The respective proportions of gas and air are best regulated by means of meters, when the pressure-gauge must of course show the same heights of water column, or the air may also be adjusted without having to pass through a meter merely by using a compression-cock on the narrow india-rubber tube, as described in a former paper.

Preparatory to an experiment the platinum tube is charged with pure soda-lime, by dropping in a lump sufficiently large to easily block up the narrow exit-tube. The whole of the wide portion of the tube, *b c*, is then gradually filled with loose pieces of soda-lime, of a size to enable the operator speedily to shake out the charge of soda-lime when the combustion is over. By gently tapping the platinum tube, held in an upright position whilst it is charged, the layer of soda-lime shakes down pretty completely, and is yet sufficiently porous to allow of a free and easy passage for the gaseous products of the combustion. The cage of spongy platinum is next introduced, and pushed down past the narrow branch tube. The gas and air connections are then made, and the platinum tube is placed upon a small combustion furnace, and heat applied to it from *a* to *c* by turning on the required number of gas burners at once. The platinum tube is best protected from the action of the gas flames by being kept imbedded in asbestos loosely spread in a thin layer along a trough made of tinned sheet iron. The supply of gas to the clay gas-burners should at no time be so great as to cause flames to shoot up above the burners or the tiles which cover the furnace. A dull red heat is sufficient, especially as much heat is generated inside the platinum tube by the combustion of the gas and air within the pores of the spongy platinum.

From ·5 to 1 cubic foot of gas can conveniently be burned per hour, requiring from 5 to 10 cubic feet of air for its complete combustion. An experiment can thus be done in three to four hours, since as a rule 2 to 4 cubic feet of gas burned in the manner described yield sufficient sulphuric acid for an accurate weighing in the form of sulphate of barium.

The experiment over, the tube is allowed to cool in a slow current of air alone. The two ends are disconnected, and the cage of spongy platinum drawn out by means of a copper wire having a little hook at one end. A stout bit of platinum wire in the form of a loop or ring may also be attached to the cage, for the more ready removal of the platinum cage. The latter is placed into a good-sized test-tube, and treated repeatedly with boiling distilled water, acidulated in the test-tube with a little dilute hydrochloric acid, in order to remove a little sulphuric acid which the spongy platinum retains. The soda-lime is next shaken out into a high beaker, and the tube washed out with hot dilute hydrochloric acid. This is most conveniently done by moving the platinum tube, held in a horizontal position, with its contents of dilute acid backwards and forwards in a small Bunsen gas flame. The rinsings are poured over the solid soda-lime contained in the beaker. Loss from spirting must be guarded against by rapidly covering the beaker with a large watch-glass after each addition of hydrochloric acid, as long as an effervescence takes place. The soda-lime is completely dissolved by the application of a gentle heat, and the carbonic acid must be entirely driven off before the sulphuric acid can be precipitated by means of a solution of chloride of barium. On gently heating for some time, the precipitate falls out readily and completely, and may be filtered off after standing for a short time, and ignited and weighed as sulphate of barium.

I need not explain that the sulphuric acid can also be estimated volumetrically by means of a standard solution of chloride of barium.

In conclusion, I will shortly point out the advantages of the new method[*] of estimating sulphur in coal gas over that now in use, and known as Dr. Letheby's sulphur test, viz.:—

1. *Perfect* combustion of the gas in a *close* vessel, at a very high temperature.
2. Complete and easy absorption of the sulphuric acid generated by the oxidation of the bisulphide of carbon, in the *same* vessel in which it was generated.
3. No loss from imperfect condensation.
4. Possibility of completing an experiment in a few hours' time, or, as seems most desirable, during the time of the evening when the greatest consumption of gas occurs.

ON SOME EFFECTS OF THE HEAT OF THE OXY-HYDROGEN FLAME.[†]

By WILLIAM ODLING, M.B., F.R.S.

I.

Chemical changes, whether of combination or decomposition, result in the production of new bodies which, under the conditions of the change, have for the most part a greater stability than the original bodies.

One evidence of this greater stability is afforded by the development of a quantity of heat—the heat of chemical action—from the produced bodies having a smaller potential heat than the original ones.

It results, both from reason and experiment, that in order to undo or reverse any definite chemical action, just so much heat must be directly or indirectly expended as was evolved by the original action.

For the same quantity of heat evolved, the resulting temperature varies with the mass and kind of matter heated, and with the rapid or gradual evolution of the heat.

When the evolution of heat is instantaneous, the resulting temperature may be calculated from the quantity of heat evolved, and the mass and specific heat, &c., of the matter heated.

By a unit of heat is meant the quantity of heat necessary to raise the temperature of one kilogramme of water one degree Centigrade, or more accurately from 0° to 1°.

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[*] Mr. Hartley, of the firm of Messrs. Wright and Co., 55, Millbank Street, Westminster, is prepared to supply the apparatus for the new sulphur test.

[†] A lecture delivered before the Royal Institution, Friday, May 22, 1868.

II.

Every 18 grammes of water is a combination of two 1-gramme proportions of hydrogen H, with one 16-gramme proportion of oxygen O; and by the combination of two grammes of hydrogen with sixteen grammes of oxygen, there are developed 68 units of heat.

Of these 68 units of heat, however, little more than 57 units are really due to the chemical action,—nearly 11 units of heat being evolved by the contraction of the original mixed gas into two-thirds its volume of steam, and by the further condensation of the resulting steam into 18 cubic centimetres of water.

While the quantity of heat evolved by the combination of a given quantity of oxygen and hydrogen is invariable, the intensity of the heat may vary from a scarcely recognisable rise of temperature up to the highest temperature of the oxy-hydrogen blowpipe flame, capable of fusing platinum and silica.

A most remarkable effect of the intense temperature resulting from the combination of oxygen and hydrogen into water, is the partial decomposition of water into oxygen and hydrogen, discovered by Mr. Grove in 1846.

At this high temperature, hydrochloric acid and carbonic anhydride gases also undergo partial decomposition, into hydrogen and chlorine, and into carbonous oxide and oxygen respectively.

Upon what do these singular decompositions by heat, of bodies formed with great evolution of heat, depend; or with what class of chemical phenomena may they be associated?

III.

Under certain familiar conditions, chemical action seemingly takes place to its utmost possible extent in a single direction only, with production of a maximum amount of the substance that is formed with maximum evolution of heat.

For example, taking atomic proportions in grammes, the heat of formation of chloride of zinc, $ZnCl_2$, is 101 units, and the heat of formation of chloride of copper, $CuCl_2$, is 60·5 units. Hence, with chlorine in solution and excess of both copper and zinc, there is finally produced the maximum possible amount of chloride of zinc and no chloride of copper.

Again, an addition of sufficient zinc to solution of chloride of copper, there is complete combination of chlorine with zinc and complete separation of chlorine from copper, *i.e.* complete burning of the one metal and complete unburning of the other.

IV.

But under simpler though less familar conditions, chemical action habitually takes place in more than one direction simultaneously, with production of correlative products in varying proportions.

Thus, with hydrogen and excess of both chlorine and oxygen, although the heat of formation of oxide of hydrogen H_2O is 57 units, and the heat of formation of chloride of hydrogen $2HCl$, is only 47·5 units, yet, in this case, the hydrogen does not combine with the oxygen to the exclusion of the chlorine, but divides itself between the oxygen and the chlorine in proportions which vary with the conditions of the experiment.

In accordance with this result it is found that, at the same red heat excess of chlorine, will effect the partial decomposition of water with extrusion of oxygen; and conversely, that excess of oxygen will effect the partial decomposition of hydrochloric acid with extrusion of chlorine.

So that, beginning with the two chemical substances, water and chlorine, or beginning with the two chemical substances, hydrochloric and oxygen, or beginning with the three chemical substances, hydrogen, chlorine, and oxygen, there exist, at a full red heat, the four chemical substances, water, hydrochloric acid, chlorine, and oxygen; the proportions of the four substances depending certainly upon the relative quantities present of the elements concerned, and most probably also upon the temperature of the experiment.

Similarly, beginning with the one chemical substance, water (Grove), or beginning with the two chemical substances, oxygen and hydrogen (Bunsen), there always exist, at a sufficiently high temperature, the three chemical substances, water, oxygen, and hydrogen.

Although, by exposure to a red heat, the electrolytic mixture of oxygen and hydrogen gases becomes completely combined, or transformed into water, yet, as recently shown by Bunsen, at the high temperature of 2024 degrees, only one-half, and at the still higher temperature of 2844 degrees, only one-third of the mixture undergoes combination, the other one-half or two-thirds remaining in the state of mixed gas.

V.

Chemists are acquainted with many reciprocal actions comparable with those of chlorine upon water, and of oxygen upon hydrochloric acid, the most familiar instance being probably the decomposition of ignited oxide of iron by hydrogen with extrusion of iron, and the converse decomposition of oxide of hydrogen by ignited iron with extrusion of hydrogen.

Similarly, sodium will decompose the oxides of carbon, while carbon will decompose oxide of sodium; and just as a sufficient excess of chlorine may be made to effect the almost complete decomposition of a given quantity of water, so may a sufficient excess of carbon (or carbonous oxide) be made to effect the almost complete decomposition of a given quantity of sodium oxide or zinc-oxide, as in the ordinary processes for obtaining the two metals; notwithstanding that, for an equal consumption of oxygen, the respective combination heats of sodium and zinc exceed by far the combination heat of carbon or carbonous oxide.

Again, although the combination heat of oxygen and carbonous oxide is 68 units, while that of oxygen and hydrogen is only 57 units, yet, as was shown by Bunsen many years ago, upon exploding a mixture of oxygen with a joint excess of carbonous oxide and hydrogen, the oxygen does not attach itself exclusively to the carbonous oxide, but divides itself between the carbonous oxide and hydrogen in a ratio determined by their relative proportions.

EXPERIMENTS WITH PAPER FILTERS.

By CHARLES E. AVERY,

Student in the Massachusetts Institute of Technology.

The filter most commonly employed in analytical laboratories is a circular piece of paper folded twice upon itself into the form of a quadrant, and supported on a glass funnel with straight sides. This filter, though commendable in so far as it is capable of supporting the weight of a considerable column of liquid without breaking, is objectionable, inasmuch as liquids cannot pass through it so rapidly as is desirable. Since at almost every point the paper is in close contact with the glass, but little of the liquid can flow off between the filter and the sides of the funnel.

Several schemes have at various times been proposed for opening water-ways between the glass and the paper; the interposition of straws, glass rods and splinters of wood between filter and funnel, as well as fluted funnels and plaited filters are all devices looking to this end.

The advantages of the plaited filter are so great that some chemists prefer to use it, even in quantitative analysis, instead of the common form, in spite of its greater liability to break, and the difficulty of washing the precipitate.

In the laboratories of Profs. Lawrence Smith and Ordway, among the most accurate of American analysts, plaited filters are said to be employed to the almost total exclusion of the plain form.

Another excellent method of increasing the speed of filtration, first suggested in America by the German chemist, Fleitmann, consists in placing one plain filter within another of coarser fibre; for instance, a fine plain filter of Swedish paper may be placed within another plain filter of coarse German paper, supported, as usual, on a funnel.

In experimenting upon these various forms of filters, it occurred to me to fold the plain qualitative filter in two operations instead of one. In place of folding the filter doubled upon itself down the middle in the usual way, I proposed to turn down on each side of the paper a fold equal to one-quarter of the semi-circle, and then to fold the sectors of 45° arc thus formed back upon themselves.

The filter is then opened without disturbing the folded portions, and placed upon the funnel. In this form the triple side of the plain filter is broken up, and the folded portions keep open passages, instead ot hindering filtration.

This filter, as tried against the plain form, gave, 1st, 133 : 100. 2nd, 111 + : 100. 3rd, 205 + : 100.

Two plain filters ran equally in several trials; each was changed into the other's funnel, and No. 1 ran 33 per cent less than No. 2. No. 1 was dried and folded into my form; remaining in the same funnel, it ran 32 per cent faster than the other. Both filters were then opened, and showed no tear or weakness when held against the light.

As these filters gave different results in different funnels, I thought I would ascertain the cause. The water seemed to be retarded in its passage by the attraction of the glass; therefore, those funnels having the greater portion of the paper free from the glass would be the best; that is, *a broad-throated funnel, other things being equal, will filter faster than a narrow-throated funnel*.

To test this point I selected two *large* funnels; No. 1 had three times as broad a throat as No. 2. With the first filters they ran:

117 : 100   123 : 100   133 : 100   118 : 100

The reason for this low difference was found in a thin spot near the point of No. 2.

Other sets of filters gave:

2nd set	292 100	318 : 100	
3rd set	288 100	335 : 100	
4th set	300 : 100	burst.	
5th set	384 : 100	407 : 100	482 : 100
6th set	242 : 100		

In the last set a porous filter, though off the same sheet as No. 1, was given to No. 2. Throughout the whole series of experiments every fair advantage was given to the weaker party, it being the first filled and the last emptied.

To make assurance doubly sure, I tried filters in like funnels, stopping the pores of the paper at various points. Paraffin applied whilst liquid was the substance first used to prevent filtration.

Two filters were chosen from the same sheet and of as uniform a texture as possible. No. 1 was stopped over one-third the radius from the point. No. 2, all but one-third the radius at the point.

They filtered at nearly the same rate, No 1 slightly the faster. The paraffin made the paper stiff, and as water does not adhere to it, free passage was allowed between it and the funnel to the water of the upper part of No. 2.

Here we see that one-ninth of the surface of the filter, when free, did as much work as eight-ninths adherent to the glass. The experiment was repeated with glycerin instead of paraffin. No. 1 ran 28 per cent the faster. It might be objected that glycerin would wash out; so a pap of paraffin and spirits of turpentine was used to repeat the experiments. Each filter, after being painted, was wetted to prevent the spread of the mixture by capillary action. The trials were not sufficiently numerous to find a true mean, but the free point invariably ran the most—from 4 or 5 per cent excess to 100 per cent. The point was assumed to be a circle one-third the radius of the filter.

I understood the idea of the Fleitmann filter to be this, that, likening a plain filter to a peat bed resting upon an impermeable sub-soil, it might be compared to a porous substratum interpolated between the swamp and the clay bottom.

To test this idea a Fleitmann filter was made and wetted, carefully patting down and smoothing out any irregularities. It was tried against a plain filter which was placed in a funnel with but two-thirds as wide a throat as that of the Fleitmann. It ran 114 : 100; that is, the passages kept open by the elasticity of the paper, the creases and abutting edges liken this filter to tile drainage.

To increase the size and number of passages I tried putting the inner filter into a plaited filter of coarse paper. Changing the filters after each trial, I found this form gave the following results as compared with the plain filter, calling the latter one hundred.

1st trial	184 : 100	4th trial	166 : 100
2nd ,,	201 : 100	5th ,,	170 : 100
3rd ,,	250 : 100		

I afterwards found a thin spot in the plain filter of the fourth trial.

Next a precipitate of sulphate of calcium was tried; the filtrates were as 131 : 100. On weighing the precipitates collected they were as 200 : 100.

This form of filter was abandoned, since it does not filter as fast, is not as strong, takes more time to make and care to use than the form next to be described. It is, however, better than the plain filter as regards speed of filtration, equal to the plaited in this respect, and stronger than it.

To admit the use of very broad-throated funnels the number of outside filters was increased to two; these over-coats were pierced with long narrow apertures running from the point to the circumference.

In the following experiments, the improved filter was tried against the *plaited* form. The improved filter, on account of its great strength, was allowed a funnel with a throat once and a half as broad as that given to the plaited filter. It would have borne one three times as broad.

1st trial	121 : 100	3rd trial	112 : 100
2nd ,,	125 : 100	4th ,,	115 : 100

The fifth trial was made with a precipitate of sulphate of calcium; the filtrates were 82 : 100. Here the new filter seemed at fault, but on weighing the precipitates collected they were as 140 : 100. The new filter being last filled, got the thicker portions each time, whilst the plaited filter got the weak top liquor.

The outer jacket is cut by folding the filter as a plain filter and taking out a sliver on each edge; repeating the process increases the number of apertures. If the filters are to be used double, as in broad-throated funnels, the openings should extend nearly to the vertex; if they are used single, in common funnels the openings need not extend so far, and the extreme point may be removed.

A thick porous felt might be used for acid liquors as an outer filter. Cotton cloth would serve in alkaline solutions; gun-cotton could be used with either. If asbestos cloth could be procured it would probably be the best. It might be cleansed by burning, and would be unaffected by anything likely to be filtered in quantitative analysis, nor would it harm the filtrate when estimations are to be made by permanganate of potassium.

Most coarse filter paper is "stuffed" with minera matter; such paper must of course be washed in acidulated water before being used for quantitative work, where the filtrate is to be saved.

When the precipitate is dry, the outer filters are thrown away, only the fine inner filter being burned.

Plaited and plain filters were tried in like funnels; calling the plaited filters No. 1, we had:

	I.	II.		I.	II
1st trial	116 :	100	3rd trial	236 :	100
2nd ,,	237 :	100	4th ,,	136 :	100

5th ,, with sulphate of calcium precipitate, 231 : 100 the precipitates weighed 166 : 100.

I then tried plain filters off the same sheet against each other in like funnels; usually the results varied but a few per cent, though sometimes much more; the greatest difference noticed was 2 to 1; several times the results corresponded exactly on repeated runs of 500 cubic centimetres.

Experiments were made to determine the difference in efficiency between the single and the triple sides of filters. No. 1 had its triple side covered with paraffin, leaving the single side free. No. 2 had the triple side free, while the single was covered; with paraffin the result was 175 : 100; glycerin was then tried with the resuult 200 : 100, showing the additional paper considerably retarded the flow.

I thought, since the adhesion of the water to the glass is the cause of slow filtration, I might increase the flow by coating the funnels on the inside with paraffin, to which water does not adhere. No. 1, being coated, No. 2, left clean, I got

	I.	II.		I.	II.
1st trial	200 :	100	3rd trial	100 :	100
2nd ,,	184 :	100	4th ,,	137 :	100

The filters in the third and fourth trials were the same, but the funnels were changed about.

The outside or skeleton filters, above described, may be cut the same size as the inner filter; if much smaller the upper part of the inner filter clings to the glass; if larger a part of the precipitate is liable to adhere to the outer filter, and even with great care a part of the precipitate would creep up and be lost.—*American Journal of Pharmacy.*

EXPLOSION OF NITROGLYCERINE, AT SYDNEY, NEW SOUTH WALES.

We have received the report of the Board appointed to enquire into the origin and causes of an explosion which occurred at Sydney, on the 4th of March, which is so full and comprehensive that we have made some extracts from it, for those of our readers who are interested in the subject. A case, containing 100 lbs. of nitroglycerine, had been sent from Messrs. Nobel and Co., of Hamburg, to Mr. Winckler, of Sydney, to whom they had offered the agency. It was laid in a cellar where there was no gas or anything of an explosive nature; but about four days after, this disastrous event occurred. In seeking for the cause of the explosion, the Board, consisting of the Hon. A. Campbell, M.L.C.; Professor J. Smith, M.D., of Sydney University; and Capt. J. McLerie, Inspector-General of Police, reviewed the following suppositions:—

(*a*). Some burglar may have entered the cellar, and in trying to break open the case, in the hope of finding spirits, may have caused the oil to explode. But if so, some remains of a human body would certainly have been found; and besides, it would have been difficult to break into the cellar, and there was nothing to tempt a burglar.

(*b*). Something may have taken fire in the premises and communicated to the oil. But if so, some sign of combustion must have remained besides the charring of the gunny-bags. There were no gunny-bags in the cellar; none, in fact, but in the loft above the store; and we may account for two or three being partially burnt by supposing that the small sample bottles of gunpowder had been broken and ignited by the explosion, and had then ignited the bags; or a box of matches may have been ignited and scattered among them. Whatever caused the charring of the gunny-bags, we are certain that they did not cause the explosion, nor were directly ignited by the explosion; they must have been ignited indirectly, and probably in one of the ways above indicated.

(*c*). The oil may have been exploded by a blow or concussion, as it is admitted by the manufacturers that a blow under certain conditions will cause an explosion. We can imagine only two ways in which such a blow could be given, supposing it proved that no person was in the cellar at the time. First, a stone may have been thrown in from the street; but this is impossible from the relative positions of the window and the box. Second, a heavy body may have fallen on the box. The only thing we could discover that could have fallen on it, was an upright post supporting one of the beams; but a careful inspection showed clearly that this post had been blown away from where it stood, the base being dislodged before the top, and breaking away a portion of the stone on which it had rested.

(*d*). The high temperature to which the oil was subjected in the cellar may have caused some sort of fermentation resulting in explosion. It is asserted by the patentees that it will not explode by the application of a lighted match, but that it will by a temperature of about 360°. But it may be conceived that a much lower temperature may cause a sort of fermentation ending in the same result. But this cellar was cool and well ventilated. The temperature of the air, on the 3rd and 4th of March, was not higher than 77°, and the cellar must have been several degrees lower; on the 22nd it was not higher than 75°, and on the 1st than 71½°. The oil must have been subjected to a higher temperature within the tropics; and on the day on which it was landed and taken to the Queen's Warehouse the thermometer at the Observatory rose to 101° in the shade.

They then report as follows:—

Having thus examined and dismissed various supposable external causes of the explosion, we are impelled to the conclusion that the cause lay within the oil itself—in other words, that it exploded spontaneously. This we allow is an unsatisfactory conclusion, and to many it may appear inadmissible. How, it may be asked, could this oil stand the rough handling and the vicissitudes of temperature that must have attended its progress from Hamburg to Sydney, and then, three days after being quietly deposited in a cool cellar, without any new condition supervening, spontaneously explode. Every effect must have a sufficient cause. To speak of this oil as exploding of its own accord, without external agency, is to endow it with a kind of conscious volition, leading it as it were to commit suicide! We admit the force of the objection, but call attention to the following considerations:—In a complex organic fluid like nitroglycerine, it is clear that the atoms are not in a condition of stable equilibrium,—their strongest chemical affinities are not satisfied—they are held together by some constraint, so to speak—in what we may call an unnatural sort of combination, and out of this combination they have a constant tendency to spring, and rearrange themselves in accordance with their stronger proclivities. For example, we know that oxygen has a much stronger attraction for carbon and for hydrogen than it has for nitrogen, and when the chemical affinities of these are fully satisfied, the carbon would be converted into carbonic acid, and the hydrogen into water in each case by union with oxygen; but in this nitroglycerine there is no carbonic acid or water, and there is good reason for believing that most of the oxygen is combined with nitrogen—hence the justification of the expression used above—that we have here an unnatural sort of combination, in which the stronger attractions are unsatisfied; and these unsatisfied attractions are really the source of the enormous potential energy locked up in the blasting oil.

Further, it is believed that the ultimate particles of all bodies (even the most solid) are in a state of continual motion, and this motion, in the case of compounds in a state of unstable equilibrium, tends to bring about, sooner or later, a condition of stable equilibrium, where the preponderating attractions are satisfied. Such changes (which are familiar to chemists) are usually slow and silent, but sometimes they are sudden and violent. In the case before us we have said that the particles are held by some constraint in an unnatural position; now, it is conceivable that, by the molecular motions spoken of, the constraining force is gradually weakened, until a period comes when it can no longer resist the strong affinities of the atoms, and they rush together suddenly, producing an enormous bulk of gaseous compounds at a very high temperature, and thus developing an immense mechanical force. If we suppose a strong spring to be kept down by a piece of wood in a condition of slow decay, it is clear that, sooner or later—though months or years may elapse—a moment must arrive when the restraining force must give way, and the spring will suddenly develope its long pent-up energy.

It is possible that the changes thus indicated in the nitroglycerine may have been promoted by the high temperature to which it must have been subjected during the voyage, and after its arrival in Sydney; and perhaps in a cooler climate it might be safely kept for an indefinite time; though there is reason to suspect that an explosion of nitroglycerine, mentioned in the newspapers as having occured last November, in Westphalia, was also spontaneous, or without external agency.

As to the question of culpability in connection with this remarkable accident, we have come to the conclusion that no one is particularly to blame. The importers had reason to believe that the blasting oil was not more dangerous than gunpowder, if so much so; and the quantity did not exceed what they would have been authorised by law to store of gunpowder; but among the dozen of Colonial Acts that affect gunpowder, we do not find one that affects the quantity that may be stored of any other explosive substance. Then there was no concealment of the nature of this substance. We find that the "sight entry" describes the cases as containing "blasting oil," and Mr. Winckler explained to the Collector of Customs that it was a substitute for blasting powder. No doubt there was an infringement of the Colonial Act 18 Victoria, No. 21, which provides that no gunpowder, or other explosive material, shall be shipped or delivered, without a plain and durable brand or superscription on the package, showing the nature and quantity of the contents; but who could be proceeded against? The shippers are not in our power, and the captain of the ship that "delivered" the cases knew them only as containing "merchandise." But supposing the case had been legibly marked "blasting oil," there is no reason to suppose that it would have been treated otherwise than it was; for the above-named Act provides only for the branding, and no other Act that we can find refers at all to other explosive materials than gunpowder.

In regard to the expected importation of 200 lbs. of nitroglycerine, we adopt and recommend the suggestion of the Collector of Customs—that the ship having this substance on board should not be allowed to come further up the harbour than Fort Denison, until the nitroglycerine be either thrown overboard, or landed on some unpeopled spot; and we further recommend to the Government to take such steps as may be necessary to ascertain, before arrival, the name of the ship by which this substance has been sent, and to give due warning and instructions to the pilots.

The question of the storage of future importations has engaged our special attention. It may turn out to be a question of no practical importance, as we hope that the serious accident that has occurred will have the effect of altogether stopping importations; but in the mean time we recommmend that an Act should be passed without delay, providing that no nitroglycerine shall be kept in any inhabited house, and that no quantity greater than two pounds shall be stored under any one roof within the city or suburbs unless it be over 100 yards from any inhabited house; and that no quantity greater than 10 lbs. shall be stored within 300 yards of any inhabited house or public thoroughfare. Quantities greater than 10 lbs. must not be stored within the city or suburbs, but must be placed in a proper magazine, in such a position, and at such a distance from habitations or thoroughfares, as would ensure the public safety.

RELATIVE VALUES OF FRENCH AND ENGLISH WEIGHTS AND MEASURES.*

By A. A. FESQUET.

Weights.

Milligramme	=	0·015438395	troy grain
Centigramme ..	,,	0·15438395	,, ,,
Decigramme	,,	1·5438395	,, ,,
Gramme	,,	15·438395	,, grains
,, ...	,,	0·643	pennyweight
,, ...	,,	0·03216	oz. troy
,, ...	,,	0·03527	oz. avoirdupois
Decagramme	,,	154·38395	troy grains
,, ...	,,	5·64	drams avoirdupois
Hectogramme ..	,,	3·2154	oz. troy
,, ..	,,	3·527	oz. avoirdupois
Kilogramme	,,	2·6803	lb. troy
,, ...	,,	2·205486	lb. avoirdupois
Myriagramme ..	,,	26·803	lb. troy
,, ..	,,	22·05486	lb. avoirdupois
Quintal metrique ..	,,	100 kilog. =	220·5486 lb. avoir.
Tonne	,,	1000 ,, ,,	2205·486 ,,

Different authors give the following values for the gramme:—

Gramme	=	15·44402	troy grains
,,	,,	15·44242	,,
,,	,,	15·4402	,,
,,	,,	15·433159	,,
,,	,,	15·432	,,

Avoirdupois.

Long ton = 20 cwt. = 2240 lb.	=	1015·649	kilogrammes
Short ton (2000 lb.)	,,	906·8296	,,
Hundredweight (112 lb.) ..	,,	50·78245	,,
Quarter (28 lb.)	,,	12·6956144	,,
Pound = 16 oz. = 7000 gr.	,,	453·4148	grammes
Ounce ,, 16 drams ,, 437·5 gr.	,,	28·3375	,,
Dram ,, 27·344 grains	,,	1·77108	gramme

Troy (precious metals).

Pound	= 12 oz.	= 5760 gr.	=	373·096	grammes
Ounce	,, 20 dwt.	,, 480 ,,	,,	31·0913	,,
Pennyweight ..		,, 24 ,,	,,	1·55457	gramme
Grain		,, ...	,,	0·064773	,,

Troy (pharmacy).

Ounce	= 8 drams	= 480 gr.	=	31·0913	grammes
Dram	,, 3 scruples	,, 60 ,,	,,	3·8869	,,
Scruple ,,	.. ..	.. 20 ,,	,,	1·29546	gramme

Carat Weight for Diamonds.

1 carat	=	4 carat grains =	64 carat parts
,,	,,	3·2	troy grains
,,	,,	3·273	,,
,,	,,	0·207264	gramme
,,	,,	0·212	,,
,,	,,	0·205	,,

Great diversity in value.

Symbols for Abbreviations.

	Unit	metre m.	gramme g.	litre l.	are a.
M	Myria	Mm	Mg	Ml	
K	Kilo	Km	Kg	Kl	
H	Hecto	Hm	Hg	Hl	Ha
D	Deca	Dm	Dg	Dl	Da
d	deci	dm	dg	dl	da
c	centi	cm	cg	cl	ca
m	milli	mm	mg	ml	

Km = kilometre. Hl = hectolitre.

cg = centigramme. c.cm = $\overline{\text{cm}}^3$ = cubic centimetre.

$\overline{\text{dm}}^2$ = sq. dm = square decimetre.
kgm = kilogrammetre.
kg° = kilogramme degree.

No. of Units.	Francs into Shillings.	Pence into Centimes.	Shillings into Francs.	Pounds sterling into Francs.
1.	0·79365	10·5033	1·2604	25·2080
2.	1·58730	21·0066	2·5208	50·4160
3.	2·38095	31·5099	3·7812	75·6240
4.	3·17460	42·0132	5·0416	100·8320
5.	3·96825	52·5165	6·3020	126·0400
6.	4·76190	63·0198	7·5624	151·2480
7.	5·55555	73·5231	8·8228	176·4560
8.	6·34920	84·0264	10·0832	201·6640
9.	7·14285	94·5297	11·3436	226·8720
10.	7·93650	105·0330	12·6040	252·0800

Conventional value of 1 shilling .. .. = 1·26 franc.
Mint value (previous to 1818) .. .. .. ,, 1·24 ,,
,, (after 1818) .. .. .. ,, 1·16 ,,
1 franc = 100 centimes = 20 sous.
5 centimes = 1 sou. 10 centimes = 1 decime = 2 sous.

No. of Units.	Inches into Centimetres.	Feet into Metres.	Miles into Kilometres.
1.	2·539954	0·3047945	1·6093
2.	5·0799	0·6095890	3·2186
3.	7·6199	0·9143835	4·8279
4.	10·1598	1·2197680	6·4373
5.	12·6998	1·5239724	8·0466
6.	15·2397	1·8287669	9·6559
7.	17·7797	2·1335614	11·2652
8.	20·3196	2·4383559	12·8745
9.	22·8596	2·7431504	14·4838
10.	25·3995	3·0479450	16·0930

No. of Units.	Square Ft. into Square Metres.	Cubic Ft. into Cubic Metres.	Pounds per square Inch into Kilogrammes per square Centimetre.
1.	0·09290	0·028314	0·0702774
2.	0·18580	0·056628	0·1405548
3.	0·27870	0·084942	0·2108322
4.	0·37160	0·113256	0·2811096
5.	0·46450	0·141570	0·3513870
6.	0·55740	0·169884	0·4216644
7.	0·65030	0·198198	0·4919418
8.	0·74320	0·226512	0·5622192
9.	0·83610	0·254826	0·6324966
10.	0·92900	0·283140	0·7027740

No. of Units.	Kilogrammes per sq. Millimetre into Pounds per sq. Inch.	Pounds into Kilogrammes.	Long Tons into Tonnes of 1000 Kilog.
1.	1425·45	0·4534148	1·015649
2.	2850·90	0·9068296	2·031298
3.	4276·35	1·3602444	3·046947
4.	5701·80	1·8136592	4·062596
5.	7127·25	2·2670740	5·078245
6.	8552·70	2·7204888	6·093894
7.	9978·15	3·1739036	7·109543
8.	11403·60	3·6273184	8·125192
9.	12829·05	4·0807332	9·140841
10.	14254·50	4·5341480	10·156490

Thermometers.

Calsius or Centigrade.	Fahrenheit.	Réaumur.
− 15° C.	+ 5° F	− 12° R
,, 10	,, 14	,, 8
,, 5	,, 23	,, 4
0	,, 32	0
+ 5	,, 41	+ 4
,, 10	,, 50	,, 8
,, 15	,, 59	,, 12
,, 20	,, 68	,, 16
,, 25	,, 77	,, 20
,, 30	,, 86	,, 24
,, 35	,, 95	,, 28
,, 40	,, 104	,, 32
,, 45	,, 113	,, 36
,, 50	,, 122	,, 40
,, 55	,, 131	,, 44
,, 60	,, 140	,, 48
,, 65	,, 149	,, 52
,, 70	,, 158	,, 56
,, 75	,, 167	,, 60
,, 80	,, 176	,, 64
,, 85	,, 185	,, 68
,, 90	,, 194	,, 72
,, 95	,, 203	,, 76
,, 100	,, 212	,, 80

1° C = 1° 8 F = $\frac{9}{5}$° F = 0° 8 R = $\frac{4}{5}$° R.

1° C × $\frac{9}{5}$ = 1° F	1° F × $\frac{5}{9}$ = 1° C	1° R × $\frac{9}{4}$ = 1° F
1° C × $\frac{4}{5}$,, 1° R	1° F × $\frac{4}{9}$,, 1° R	1° R × $\frac{5}{4}$,, 1° C

Calorie = Unit of heat.
,, ,, Kilogramme degree = Kg°.

It is the quantity of heat necessary to raise of 1° C. the temperature of 1 Kilogramme of distilled water.

Kilogrammetre = Kgm. = the power necessary to raise 1 Kilogramme 1 metre high in 1 second. It is equal to $\frac{1}{75}$ of a French horse-power.

FOREIGN SCIENCE.

Paris, June 17, 1868.

Estimation of phosphoric acid.—Oxidation of alcohol.—Aniline black varnish.—Treatment of beet-root pulp.—Extraction of sugar from beet-root juice and molasses of all descriptions. Academy of Sciences: Combustion of oil.—Chemical harmonica.

Reference has already been made to M. Schlœsing's process of determining phosphoric acid; the following is the manner in which the experiment is made:—A tube of green glass is fashioned before the blowpipe, so that there is first a part (A) of 30 centimetres in length, which rests horizontally upon wire gauze, and where the reactions take place; then a part drawn out of about 15 centimetres in length, inclined downwards and backwards, after which the tube is continued horizontally, and with the original diameter, for the length of 10 centimetres. Thus there is formed a kind of bulb (B), terminated by a recurved point, destined to condense the chloride of phosphorus. At the end of the part A, a tuft of asbestos is placed, and upon this pure chloride of potassium, decrepitated and coarsely powdered: this chloride occupies from 12 to 15 centimetres, and is maintained in its place by another very small tuft of asbestos. Afterwards the porcelain boat, containing the phosphide in fragments, with a last tuft of asbestos, is introduced. Finally, the end of the tube is closed by a cork carrying a little piece of tube. In the bulb, B, a little water is placed, and a vertical tube containing fragments of moistened porcelain is attached, where phosphoric vapours not condensed in B will be condensed. After this arrangement comes a little washing flask, serving to show the current of chlorine. After having heated the

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chloride of potassium, and driven every trace of moisture out of A, by a current of dry air, the chlorine is admitted; but the porcelain boat is not heated till the tube has been swept through with dry air. As soon as the reaction commences, a red liquid is condensed round the boat, and spreads over the chloride of potassium. This chloride ought to be heated, but only near the boat, to a sufficiently high temperature to melt the double chloride, otherwise the tube will become closed up. Towards the end of the operation the heat is raised a little, without at the same time allowing it to reach dull redness, for at this degree of heat the phosphorus exchanges its chlorine for the oxygen of the silica of the glass, and forms phosphates. The perchloride of phosphorus is condensed at the end of the tube A; by application of a gentle heat it is chased into the bulb. The experiment is finished when the least trace of condensation is no longer observed. A constant but feeble excess of chlorine should be maintained throughout, and the operator requires to have the chlorine easily at command; for this, the arrangement with a couple of tubulated flasks and pinchcocks is convenient.

To determine the phosphoric acid condensed in the bulb with hydrochloric acid the glass is cut in the narrowed part, the liquid transferred to a porcelain dish, and the washings of the bulb and the tube with porcelain united, nitric acid added, and the whole evaporated. The hydrochloric acid, decomposed towards the end of the operation, is eliminated without loss. All that is now required is to estimate free phosphoric acid in the presence of nitric acid, and for this purpose M. Schlœsing employs nitrate of silver.

It has been frequently remarked by vinegar makers that the acetification of alcohol in the casks does not proceed regularly, and that the corresponding strength of acid is not obtained. To facilitate oxidation, M. Artus dissolves 15 grammes of dry chloride of platinum in 2·5 kilogrammes of alcohol, and in the solution places 1·5 kilogramme of pieces of wood charcoal in pieces of the size of a nut; he then calcines in a covered crucible. This done, he takes 0·75 kil. of platinised carbon, and strews it upon a wooden cover pierced with holes, placed over the open top of a vinegar cask, 2 metres in height and of from 0 m. 80 to 0 m. 90 in diameter; the vinegar is not allowed to moisten directly the cover with the platinised carbon. After five weeks' work, the platinised carbon is calcined afresh. The action of this carbon is very remarkable, the acetification is effected more rapidly and completely than in operating in the ordinary way, and the vinegar possesses a more agreeable flavour.

An aniline black varnish, of recent Parisian production, is the following:—In a litre of alcohol 12 grammes of aniline blue, 3 grammes of fuchsine, and 8 grammes of naphthaline yellow, are dissolved. The whole is dissolved by agitation in less than twelve hours. One application renders a white object ebony black; the varnish can be filtered, and will never deposit afterwards. The three colours are not destroyed, for each can be separated by analysis with the characteristic properties.

A modification in the treatment of beet-root pulp has been introduced by M. Champonnois. The experiments relative to the process were made in the laboratory of MM. Périer and Persoz, and subsequently repeated in the laboratory of the *Conservatoire des Arts et Métiers*. The quantity of beet-root operated upon in each case was two kilogrammes. This amount was grated, 30 per cent of water added, and the pulp pressed in the usual way. The juice was filtered through paper, concentrated, with addition of 1 per cent of fine animal black, purification which is considered equivalent to an ordinary filtration, working with coarser material. This syrup was concentrated to 22° Beaumé, filtered, and heated to 115° C., then left on a stove during five or six days; the crystallised mass was then freed from mother liquor. For the second, and for all following operations, this drained syrup, or molasses, was diluted with about 60 per cent of water for the weight of beet-root; this solution heated on the water-bath, and mixed with the pulp of 2 kilogrammes of beet-root, was maintained from ten to fifteen minutes at a temperature of 70° to 80°. The mass was then treated precisely as in the former case. The smallest particles of syrup adhering to the vessel crystallise completely and in large crystals. In the regular process of manufacture, the syrup removes about double the amount of albumen and salts, retained by the pulp; all these things are separated in purification, or remain in the molasses, and are consesequently lost as alimentary matters. The pulps obtained in the new process, on the contrary, retain all these matters, and are much smaller in weight than the ordinary pulps; they can then, being returned to the farm, yield valuable materials, particularly the salts, which are rapidly removed from the soils upon which beet-root is cultivated; even this is the case when the quantity of ordinary pulp proportional to the beet-root which the matters in the soil have produced, is restored to the soil, for this proportion corresponds only to one-third, at the most, of the useful principles contained in the beet-root. By the continued recharging of the syrups, the work relating to bye-products is suppressed, work which requires a large outlay in cisterns and very large refineries. The only inconvenience that is met in the process advocated, resides in the proportion of water, which is double that commonly employed; but the increase in expense is alone due to carbon, and amounts to 1 franc more for 1,000 kilogrammes of beet-root: it is true that the apparatus destined to contain the juice is required to be somewhat larger. These facts are insignificant in comparison with the advantages of the new method, considered both in regard to the farm and the factory.

Apropos of the beet-root manufacture, M. Leplay's method of extracting sugar from juice as well as syrups and molasses of all descriptions, may be here referred to. M. Leplay sought to extract the sugar from the matters in question, by transforming it into insoluble sucrate of lime, which has not yet been made on an industrial scale. This combination is effected in the saccharine fluids treated, less by an addition of ready formed free lime, than by the aid of solutions of calcareous salts, and particularly of chloride of calcium, and of caustic soda, which precipitates the lime, and this combines and is precipitated with the sugar. The sucrate of lime, after precipitation, is decomposed by means of carbonic acid, the soda in the solution regenerated, and the carbonic acid obtained as a secondary product in the formation of the chloride of calcium. A few additional statements of the author will render the precise nature of the process more evident.

When a solution of sugar in water is saturated with all the lime which it is capable of absorbing, and boiled, there is formed a white precipitate of sucrate of lime, which is redissolved on cooling. The quantity of sugar thus eliminated is only a small proportion of that present, and the greater part remains in solution when the precipitate is separated from the liquid during ebullition. Feebler still, is the proportion of sugar that can be extracted from beet-root juice or molasses, and the more impure the saccharine fluid is, the less considerable is the separation obtained by this means. On the contrary, the whole of the sugar may be precipitated in the state of sucrate of lime, when in the solution already saturated with lime, a fresh quantity of lime is separated in the nascent state, then the precipitation is independent of the degree of purity of the saccharine solutions. Besides the juice of the beet-root, the molasses of sugar refineries are capable of treatment by the process. The quantity of soluble salts of lime present in the syrups, &c, exerts an influence on the proportion of calcareous salt which should be added; as these salts contain organic acids, the soda is no longer found in corresponding quantity, as chloride of sodium, but as carbonate of soda in the ash obtained from the mother liquor,—an important advantage. The previous saturation of the liquor submitted to treatment by pure lime, before the addition of the calcareous salt, is then essential, since by this means a portion of the calcareous salt which would be otherwise required, is replaced by the cheaper material, lime. The sucrate of lime precipitated is separated from the liquor, washed with water, and decomposed by carbonic acid.

M. Scheurer-Kestner, in his memoir "On the combustion of oil," presented to the Academy, states that his researches are divided into three parts: (1) chemical study of the gas resulting from the combustion of oil, estimation of the combustible gases, and of the lampblack; (2) calorimetric studies, heat from the combustion of oil, relation between the chemical composition and the calorific power; (3) calculations and practical results, study of the distribution of caloric in the heating of steam generators. The lampblack was estimated by causing a certain volume, 50 or 100 litres, of the gaseous products of combustion to pass through a glass tube filled with asbestos, which retains this carbon completely. The tube was afterwards heated to redness, a current of oxygen passed through, and the carbonic acid formed collected in potash. It results from the analysis of the gas, that when the supply of air is insufficient, that is to say, when the gaseous products only contain six to ten per cent of air in excess, the loss of carbon in the state of combustible gas represents about 20 per cent of the carbon of the oil consumed, and that this loss diminishes considerably when the burnt gases contain 20 to 50 per cent of air in excess, becoming then reduced to 4 or 5 per cent. The loss of hydrogen is more considerable: it oscillates between 10 and 20 per cent of the hydrogen contained in the oil, and depends less on the supply of air. In fact, the disengagement of hydrogen takes place by distillation. The presence of acetylene, as well as of other hydrocarbons, has been proved. Many tables of analyses occur in the memoir. The oil experimented with was that of Ronchamp.

The following occur among the conclusions to a note "On the chemical harmonica," by M. Terquem. Relatively to the form of the flame, three cases may present themselves:—(1.) If the flame be long enough, and the current of air of little intensity, the vibratory motion does not reach the base of the flame; examined by the turning mirror, the reflected image presents the appearance of a continuous sinusoïdal curve. (2.) If the current of air, and consequently the vibratory motion, be more intense, the flame vibrates in its whole length, and can even become completely extinguished; in this case, with the turning mirror, the images of the flame are quite distinct, the gas re-lights itself by reason of the high temperature reigning at the point. (3.) If the vibratory motion become still more intense, there is observed in the disengagement tube a little reversed flame, which, seen in the turning mirror, alternates with the external flame; this almost exceptional phenomenon was the point of departure in the theory proposed by Schrötter.

CORRESPONDENCE.

UTILISATION OF WATER POWER.

To the Editor of the Chemical News.

Sir,—The question of our coal supplies must interest every one who has the prosperity of his country at heart; and Professor Jevons's lecture at the Royal Institution, printed in your Journal of 8th and 15th May, is calculated to produce, if not fear, at least thoughtfulness for the future.

It seems to me that one very obvious source of power, continually passing before our eyes as if inviting thoughtful consideration, has been thrown very much to one side as unworthy of taking a place beside steam. I refer to water power. This neglect may have been of little consequence hitherto, when coals were so plentiful and cheap; but now, when there is every prospect of coals becoming both scarce and dear, and when our growing knowledge of the convertibility of force tends to render the cheapness of the first power everything, and direct application a secondary matter, this neglect becomes a matter of importance.

Every one living in the neighbourhood of a river must be struck by the vast amount of force that passes *unutilised* down the river course during floods. Reckoned up in horse power or foot pounds it must be something enormous even in our smaller rivers. Can this force be *utilised?* The Dutch have wrested land from the depths of the sea. Is it too great a task for the English to hold back the winter floods from the ocean, and only let them out after performing their alloted task? In truth this has been done to a small extent already in our various water works, and I would suggest its being carried out to an extent worthy of the energies of this great nation meeting a threatened difficulty, and subduing the forces of nature to its own use. With the aid of the capital and enterprise of the nation, I should think there is no scientific difficulty in constructing large reservoirs at the sources of our principal manufacturing rivers, supplemented, if necessary, by smaller reservoirs along their courses at suitable points. In our northern rivers, at any rate, there are many natural basins which could with little difficulty be turned into reservoirs capable of storing abundant supplies for the largest manufactories, and keeping these supplies constant during the whole year. By this means one great objection to water power, namely its variability, would be removed.

In the application of water power also much might be done. We are merely on the threshold, so to speak, of our knowledge of the convertibility of force, and for those purposes where the direct application of water power would not be advantageous, it might be converted economically into any other force, such as electricity or heat, without making an impossible demand on our scientific skill.

Mr Jevons seems to think electricity can never supersede coal, because coal is likely to be the cheapest source of electricity, but if electricity were derived from water power this difficulty would be removed.

Were some such plan as I have sketched adopted, this country would be in possession of a power which would last while the sun shone and rivers flowed, and the seats of industry would not be the plains of Africa or Australia, as Professor Jevons hints, but would still be in "this cloud obscured Isle,"—and because it is cloud obscured.

I am &c.,

W. M. Durham.

Currie, 10th June, 1868.

MISCELLANEOUS.

Destruction of Nobel's Nitroglycerine Manufactory.—By telegram from Stockholm we learn that Nobel's nitroglycerine manufactory was blown up on the afternoon of the 10th inst. Fifteen persons were killed and several seriously injured, and great destruction was caused in the neighbourhood of the works.

Chemical Society at Newcastle-upon-Tyne.—We hear that Mr. R. Calvert Clapham and Mr. Freire Marrico are making arrangements to establish a Chemical Society at Newcastle. There are a considerable number of practical chemists in the neighbourhood, and this movement will, in all probability, be well supported. Such a Society, well managed, cannot fail to promote the advancement of practical and theoretical chemistry, and we trust that our columns will soon record the proceedings of the Newcastle Chemical Society, in addition to those of the other learned societies.

A New Lamp.—The French, who were always strong in "lamps," have lately brought out a new invention, which is said to be as brilliant as the oxy-hydrogen and lime lights, while it has the recommendation of being much less costly. Coal gas, intimately mixed with air, is urged with gentle pressure along a tube, and made to pass through a metallic plate, pierced full of minute holes. By this means a vast number of jets are obtained, which, after being driven through a fine tissue of platinum wire, are lighted in the ordinary way. The platinum soon acquires a white heat, and gives out so brilliant a light that it cannot be supported by the naked eye. About one metre of gas is consumed per hour. It is called the *Bourbouze* lamp.—*Oil Trade Review.*

On the Means of Recognising the Source of an Alcohol.—The source of an alcohol is usually ascertained by pouring a small quantity into the palm of the hand, and allowing it to evaporate; as the alcohol is more volatile than the empyreuma, the odour of the latter reveals the origin of the alcohol when the evaporation is almost terminated. But this process is very imperfect, as the alcohol may dissolve fatty substances from the hand, which will modify its odour. It is better to operate in a glass or porcelain capsule; but the following plan is still more safe:—Mix the alcohol with an equal quantity of ether, and then add a volume of water equal to that of the mixture. The ether dissolves the empyreuma, and carries it with it when separating with the rest of the liquid. Then evaporate this ether in a porcelain capsule, and the residue gives the empyreumatic odour so characteristic that it cannot be mistaken. Rum, arrack, cognac, potato, or wood spirit may thus be easily distinguished. The test only occupies a few minutes; but rectified ether must be employed, as common commercial ether also leaves an odourous residue on evaporation.—*Neue Gewerbeblätter aus Kurhessen.*

Dinner to Mr. Watts.—On the 15th instant a complimentary dinner was given at the Freemasons' Tavern to Mr. Henry Watts, F.R.S., by several of his friends and coadjutors, in celebration of the completion of his "Dictionary of Chemistry." The chair was taken by Dr. Odling, and there were also present Dr. Roscoe, Dr. Guthrie, Mr. Hanhart, Prof. Cary Foster, Dr. Atkinson, Mr. F. Field, Dr. H. Müller, Mr. David Forbes, Mr. A. P. Price, Dr. M. Foster, Dr. Russell, Dr. Gilbert, Dr. Redwood, and some others. Mr. De la Rue, Dr. Frankland, Mr. Abel, and Mr. Greville Williams were unfortunately prevented from attending. In proposing the toast of the evening, the chairman remarked upon the advantages which occurred to chemists from their having compressed into five goodly volumes an accurate abstract of the immense mass of chemical knowledge which had gone on accumulating up to the present time, and he complimented Mr. Watts upon the thoroughness and conscientiousness with which this part of his labours had been performed—that he had not been content with giving crude abstracts of scarcely more crude material, but had produced a complete system of singularly well digested abstracts, bearing upon them the stamp of his own individuality. The chairman further observed that, in addition to its being a storehouse of carefully abstracted knowledge, the dictionary was, in addition, a collection of high-class treatises upon all subjects of great chemical interest; and, although many of these treatises had been contributed by friends and associates of Mr. Watts, who had been glad to support him in his arduous undertaking, others of them, and these not the least meritorious, were the work of Mr. Watts himself, and gave evidence alike of his extensive knowledge and clear philosophical conception. The health of Mr. Watts was then drunk with much enthusiasm; other toasts followed, including "Success to the Messrs. Longmans," and the party broke up after an evening of much enjoyment.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Journal für Praktische Chemie.

Nos. 23-24. 1867.

G. Rose, "On tha Preparation of Crystallised Bodies before the Blowpipe (Continuation). On the Behaviour of Titanie Acid towards Borax, and on the Preparation of Rutile and Amorphous Titanie Acid. On the Behaviour of Oxides of Iron towards Borax, and on the Preparation of Crystallised Hæmatite and Magnetic Iron Ore. On the Behaviour of Titaniferous Iron Ora towards Borax, and on the Preparation of Crystallised Titaniferous Iron Ore and Titaniferous Magnetie Oxide of Iron. On the Preparation of Rutile by Fusing Titanic Acid and Titaniferous Iron Ore with Phosphate of Soda and Ammonia." R. Hermann, "Answer to C. Marignac's Remarks[*] on the Author's Researches on the Atomic Weight of Niobium and Ilmenium. On Rewdanskite, a new Nickel Ore, and on the Extraction of Niekel from that Mineral." F. von Kobell, "On Glaucodote from Hakansbö, Sweden." Henning, "On the Theory of the Removal of Sulphur from Gas by Oxide of Iron and of the Revivification of the same." Hilger, "On the Chemical Composition of the Shell and some soft Parts of living Brachiopoda." A. Froehde, "On the Identity of Hydrocarotine and Cholesterine." A. E. Nordenskold, "On the Selenium Minerals from the Copper Mine of Skrikerum, in the Province of Calmar, Sweden."

No. 1. 1868.

A. Muller, "On the Dialytic Solution of Caseine and Starch." A. Claus, "On the Behaviour of Acroleine towards Hydrate of Potash. Contributions to the Knowledge of Oxanilic Acid."

Dingler's *Polytechnisches Journal.*

No. 3. 1868.

A. Ott, "On the Preparation of Phenic Acid." H. Perutz, "On the Detection of Butyric Aeid in Glycerine, and on its Separation from that Substance." A. Span, "On G. C. Nollner's Method of Estimating Nitric Acid."

Annales du Génie Civil.

February, 1868.

A. D'Anhemar, "On the Deposits of Phosphate of Lime at the Island of Sombrero, Antilles." Stoss, "On the Use of Oxide of Chromium for Polishing Steel." Ziegler, "A Substitute for Animal Charcoal." Schneider, "A Method of Purifying Coal Gas by means of Iron Filings." Gondolo, "A Modification of Boussingault's Process for Manufacturing Oxygen and Nitrogen by passing a Current of Atmospherie Air over Caustic Baryta." Schwarz, "A Process for Manufacturing Seltzer Water from Carbonate of Magnesia without the Use of an Acid." Picard, "A Process for Extracting Grease from Waste Leather." Aubertin and Boblique, "On obtaining Phosphorus from Bones by means of Silica and Pounded Charcoal."

Comptes Rendus.

March 2, 1868.

Juette "On the Estimation cf Tartaric and Malic Aeid by means of Iron, Aluminium, Manganese, &c." J. Personne, "Chemical Researches on the Composition of Roasted Coffee." Deschamps, Sen., "On the Volatile Oils contained in Brandy.—Contributions to the Knowledge of Iodide of Potassium and some other Iodides."

March 9, 1868.

H. Deville, "First Memoir on the Physieal Properties and Calorific Power of Petroleum and other Mineral Oils." Fizeau, "On the Dilatation of Paraffin and Naphthaline." E. Fremy and Terreil, "On a general method for the immediate Analysis of Vegetable Tissues." A. Payen, "On the Properties and on the Extraction of Diastase." A. W. Hofmann, "On the Member of the Naphthalic Series which corresponds to Benzoic Aeid." Isnard. "A process for Determining the Equivalent of Aluminium." Bechamp, "On the Propionic Fermentation of Succinic and Malic Acid."

Monatsbericht der Koniglich Preussischen Akademie der Wissenschaften zu Berlin.

November, 1867.

Rammelsberg, "On the Composition of the Salts of Periodic Acid."

Archives des Sciences.

February 15, 1868.

C. Marignac, "On the Reduction of Niobium and Tantalum Compounds."

Annalen der Chemie und Pharmacie.

February, 1868.

R. Fittig, A Köbrich, and T. Jike, "On the Decomposition of Camphor by Chloride of Zinc in Fusion." J. H. Eaton and R. Fittig, "On the Cyanogen Compounds of Manganese." O. Malin, "On Isodulcitic Acid.—Contributions to the Knowledge of Camphor." H. Hlasiwetz and A. Grabowski, "On the Decomposition of Camphorie Acid by Caustic Potash in Fusion." W. Heintz, "On the Action of Iodide of Ethyl on Glycol Compounds and Diglycolamidic Acid Compounds, and on a new mode of formation of Diethylglycocol and Ethylglycolamidic Acid." C. Herrmann, "On the Constitution of Ferrocyanide of Cadmium and Potassium." A. Claus, "On the Reduction of Oxalic Acid."

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[*] See *Journal für Praktische Chemie*, vol. 101, p. 464.

Poggendorff's *Annalen der Physik*.
No. 1. 1868.

A. Forster, "An account of some Methods of Preparing Phosphorescent Compounds." T. Wimmel, "On the Melting Points of Fats, and on their behaviour during Solidification." C. Schultz, "On the Constitution of the Sulphates." C. Von Hauer, "On the Hydrates of the Double Sulphate of Cadmium and Potash." W. Wernicke, "On Gilding Glass Specula."

Bulletin de la Société Industrielle de Mulhouse.
February. 1868.

A. Scheurer-Kestner, "Memoir on the Extraction of Sulphur from Soda Waste."

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3463. S. Perkins and W. Smellie, Gorton, near Manchester, "Improvements in the manufacture of malleable metal of a steely quality, partly from Bessemer "scrap" or other Bessemer metal."—December 5, 1867.

3499. L. Rose, Leith, N.B., "An improved mode of preserving vegetable juices."—December 9, 1867.

3517. A. M. Clark, Chancery Lane, "An improved process for the production of tin so as to render it applicable for coating metals, and for other purposes."—A communication from J. Feuquières, Boulevart St. Martin, Paris.—December 11, 1867.

3542. E. R. Sintzenich, Duke Street, St. James's, Middlesex, "Improvements in the treatment of gutta-percha, india-rubber, Honduras gum, and the other allied gums, for the production of a preparation or preparations applicable as a varnish, cement, paint, stain, water and air-proof material, and for other purposes."—A communication from D. Reed, New York.—December 13, 1867.

3559. J. Hargreaves, Appleton-within-Widnes, Lancashire, "Improvements in the manufacture of soda and potassa."

3556. A. M. Clark, Chancery Lane, "Improvements in the extraction of ammonia from fermented and other liquids, and in the regeneration of the agents used in such extraction."—A communication from A. Coste and L. T. De Rosnay, Boulevart St. Martin, Paris.—December 14, 1867.

3581. W. Huskisson, jun., Swinton Street, Gray's Inn Road, Middlesex, "Improvements in the manufacture of bicarbonate of potash and soda."—December 16, 1867.

3652. F. A. Abel, Woolwich, Kent, "Improvements in the production of explosive compounds."

3657. A. M. Clark, Chancery Lane, "An improved colouring matter, chiefly applicable for dyeing and printing purposes."—A communication from J. T. Coupiar, Boulevart St. Martin, Paris.

3663. J. Addie, Coatbridge, Lanarkshire, and F. Kolm, Westminster, Middlesex, "Improvements relating to blast and cupola furnaces."

3667. G. J. Hinde, Wolverhampton, Staffordshire, and T. C. Hinde, Ynispenllwch, near Swansea, Glamorganshire, "Improvements in the manufacture of iron and steel, and in furnaces and apparatus used in the said manufacture."—December 24, 1867.

112. T. Whitwell, Stockton-on-Tees, "Improvements in furnaces."—January 11, 1868.

215. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in furnaces."—A communication from H. Ross, Pittsburgh, Allegheny, Penn., U.S.A.—January 21, 1868.

493. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved mode of, and apparatus for, extracting and condensing the volatile portions of ores."—A communication from F. Formhals, San Francisco, California, U.S.A.—February 13, 1868.

731. T. Johnson, Runcorn, Cheshire, "Improvements in treating ores to obtain copper therefrom, and in evaporating brine."—March 3, 1868.

759. W. Hunt, Castleford, Yorkshire, "Improvements in treating certain compounds of copper and iron, and in utilising residual products obtained in heating compounds of copper and iron."—March 5, 1868.

785. J. Houston, Glasgow, N.B., "Improvements in the manufacture of composite candles, and in the machinery or apparatus employed therein."—March 6, 1868.

830. C. Attwood, Wolsingham, Durham, "Improvements in the production or manufacture of steel and iron of a steely character."—March 10, 1868.

891. W. E. Newton, Chancery Lane, "Improvements in the manufacture of illuminating gas in the distillation of hydrocarbons, and the making of gaseous fuel for heating purposes."—A communication from L. Stevens, Washington, Columbia, U.S.A.—March 16, 1868.

923. B. E. R. Newlands, F.C.S., Charlton, Kent, "Improvements in treating and obtaining products from spent oxide of iron which has been used in gas works or otherwise, to separate sulphur from sulphuretted hydrogen, and in the purification of sulphur obtained from such oxide of iron."—March 18, 1868.

1078. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of cast steel, and in furnaces to be employed therein, which furnaces are also applicable to the remelting of metals generally."—A communication from F. Ellershausen, Ottawa, Canada.—March 30, 1868.

1130. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of cast steel and malleable iron from cast iron, and in the apparatus or means employed therein."—A communication from F. Ellershausen, Ottawa, Canada.—April 3, 1868.

1137. H. Cochrane, Middlesbrough-on-Tees, Yorkshire, "Improvements in blast furnaces."—April 4, 1868.

1222. T. Forstar, Streatham, Surrey, "Improvements in the manufacture of compounds of India-rubber, gutta-percha, balata, parkesine, solid paraffin or vegetable oils, and vegetable fibre."—April 13, 1868.

1137. H. Cochrane, Middlesbrough-on-Tees, Yorkshire, "Improvements in blast furnaces."—April 4, 1868.

1157. J. Radcliffe, Consett Iron Works, Durham, "Improvements in processes and means employed in the manufacture of iron and steel."—April 6, 1868.

1181. J. James, Ebbw Vale, Monmouthshire, and T. Jones, Govilon, Monmouthshire, "Improvements in the manufacture of iron into semi-steel or steel."

1184. W. E. Newton, Chancery Lane, "Improvements in the manufacture of salts of soda."—A communication from J. M. Gattman, New York, U.S.A.

1187. V. Gallet, Lavausseau de Benassais, Vienne, France, "Improvements in the manufacture of steel."—April 8, 1868.

1195. A. H. Still and D. Lane, Cork, "Improvements in the manufacture of gas."—April 9, 1868.

1222. T. Forster, Streatham, Surrey, "Improvements in the manufacture of compounds of india-rubber, gutta percha, balata, parkesine, solid paraffin or vegetable oils, and vegetable fibre."—April 13, 1868.

INVENTION PROTECTED BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

1167. A. L. Holley, Harrisburgh, U.S.A., "Improvements in the manufacture of iron and steel."—Recorded April 7, 1868.

NOTICES TO PROCEED.

3270. G. Fitt, Limehouse, Middlesex, "Improvements in the manufacture of artificial manure."—Petition recorded November 18, 1867.

3288. Baroness C. de Lavenant, Brixton Road, Surrey, "Improvements in coating metals and metallic articles for the purpose of protecting or preserving the same from oxidation and decay, also in the materials, machinery, and apparatus to be employed therein."—Nov. 20, 1867.

3318. P. Salmon, Great Smith Street, Westminister, Middlesex, "Improvements in the manufacture of gas, and in the treatment and application of such and other gases for cooking, warming, lighting, generating of steam, and other purposes, combined with their use as a motive power, previous to being burned or consumed, and improvements in the apparatus for these purposes."—November 23, 1867.

3340. J. P. Smith, Glasgow, "An improved mode of coating and uniting metals with metals."—November 26, 1867.

5360. H. F. Gardner, Boston, U.S.A., "Improvements in the means of, and apparatus for, treating metals and minerals in order to produce their oxides or other chemical or mechanical combinations, and to separate metals from their ores or from their alloys."—A communication from Z. A. Willard, Boston, and W. G. Adams, Franklin, Mass., U.S.A.—November 27, 1867.

NOTES AND QUERIES.

Cast Porcelain.—In answer to "Silex" I am happy to be able to afford him the information he wants. Some specimens of this material were exhibited before the last meeting of the American Pharmaceutical Association, and the mode of manufacture described. I quote the following from their proceedings:—By a fusion of 1 part of cryolite with from 2 to 4 of pure silex, a beautiful glass is formed, susceptible of mould and polish, and capable of being manufactured into an endless variety of useful and ornamental articles, and probably many utensils for chemical and pharmaceutical use will be made of it. A company has been operating in Philadelphia for some time past, on an experimental scale, entitled the "Hot Cast Porcelain Company." The results have been so satisfactory that they have now taken a large establishment, and will be prepared to carry on the manufacture quite extensively. The cost is, at present, from 10 to 20 per cent higher than ordinary flint glass. The ware seems to be stronger than glass.—Pharmaceutist.

TO CORRESPONDENTS.

Dead Oil.—A correspondent who wrote about dead oil last week is informed that several communications are waiting for him at our office.

A. Deck.—Medlock's bisulphite of lime solution may be obtained of the manufacturers, Messrs. Bailey and Son, Wolverhampton, or Lawrence Pountney Hill, London, E.C.

Dyeing.—A correspondent who enquires on this subject, but gives no name, is informed that no information on the subject named is at present in our possession.

T. D. Read.—The number of the *Technologist* shall be sent.

A. N.—A sample of benzoic acid is waiting for this correspondent at our office.

Communications have been received from H. Porter; G. Bird; C. Greville Williams, F.R.S.; J. Attfield (with enclosure); T. D. Read, Montreal; McDougall, Bros.; Dr. Odling, F.R.S.; H. W. Whiteman, U.S.A.; J. A. Wykes; J. Barrow; A. McCulloch (with enclosure); A. Deck; T. Winter; Dr. F. C. Calvert, F.R.S.; H. Seward; F. O. Ward; J. Parnell (with enclosure); Rev. A. Rigg (with enclosure); E. Dolby; Cornish, Bros.; W. Darling; J. C. Lee (with enclosure); E. Wheeler, jun.; C. J. Ellam (with enclosure); L. Demuth (with enclosure); Sir Charles Taylor; R. Hogg (with enclosure); A. Gow (with enclosure) Dr. Jaeger.

THE CHEMICAL NEWS.

Vol. XVII. No. 447.

OBSERVATIONS ON FERRIC HYDRATE.

By Professor ATTFIELD, Ph.D.

In a memoir, noticed in the Chemical News of June 12 as having been recently presented to the Academy of Sciences, M. Jeannel, in allusion to the fact that ferric hydrate is not always soluble in acids, states that the incomplete solubility is, in his opinion, generally due to the influence of traces of sulphates. He says, according to the Paris correspondent of the Chemical News, "sesquioxide, precipitated from the persulphate, is always to a certain extent insoluble, or yields unstable salts; the same is the case with the sesquioxide precipitated from the perchloride, when this has been contaminated by sulphuric acid, or equally when the alkalies employed as precipitants have been so contaminated, or, finally, when the ferric hydrate, precipitated from pure solutions by pure alkalies, has been washed with common water." This explanation does not accord with my experience of the properties of ferric hydrate and oxyhydrates. Firstly, in England the ferric citrates and tartrates used in medicine are successfully made in large quantities by dissolving ferric hydrate, prepared from ferric sulphate, in solutions of the respective acids and acid-salts. Secondly, I have frequently seen moist ferric hydrate perfectly dissolve in solutions of acids or acid-salts, even though the precipitate has been washed with common water containing sulphate of calcium, a final washing with distilled water having, for various reasons, been neglected. Thirdly, I have often noticed that pure ferric hydrate, soluble when freshly precipitated, becomes imperfectly so if long kept, moist or dry. It is true that when alkali is added to solution of ferric sulphate, instead of the latter to the former, an insoluble oxysulphate is precipitated, and a similar compound may, possibly, be formed under other circumstances; but ferric hydrate, properly prepared and fairly washed, is readily soluble if only it be used in the moist and recently-precipitated condition, with a solution of acid or acid-salt which is not too weak, and the mixture be not boiled or even strongly heated for any considerable length of time. The fact is that ferric hydrate, even though kept under water, decomposes after a time, or more quickly if heated, losing the elements of water and becoming an oxyhydrate, a body insoluble in weak acids and, also unlike ferric hydrate, incapable of acting as an antidote to arsenic, that is, incapable of forming ferrous arseniate.

It may be useful again to draw attention to the decided alteration in properties which ferric hydrate spontaneously undergoes when exposed beneath the surface of water or when boiled with water, as evidence that this substance ($Fe_2 6HO$) is a true analogue of hydrate of sodium ($NaHO$), &c., and not a hydrous ferric oxide ($Fe_2O_3,3H_2O$). It is more reasonable to suppose that in acquiring new properties ferric hydrate becomes changed to new compounds than to consider that the changes result from the loss of a portion of water already existing as water. Between ferric hydrate ($Fe_2 6HO$) and ferric oxide (Fe_2O_3) there would appear to be several oxyhydrates, analyses, &c., of most of which have already been given in the Chemical News (xvii., 56) by Brush and Rodman.

1. $Fe_4 \quad 12HO$.
2. $Fe_4O \; 10HO$.
3. $Fe_4O_2 \; 8HO$.
4. $Fe_4O_3 \; 6HO$.
5. $Fe_4O_4 \; 4HO$.
6. $Fe_4O_5 \; 2HO$.
7. Fe_4O_6

In the above formulæ, No. 1 represents two molecules of ferric hydrate; Church found a stalactite of true ferric hydrate, native, in Cornwall, and Wittstein gives a similar formula to fresh artificial ferric hydrate. No. 2 is the only oxyhydrate, in this series, still unknown, unless, indeed Haughton's Kilbride mineral contains this body. No. 3 is brown iron ore from the Hüttenrode Hartz. No. 4 is the formula of a limonite and of artificial ferric hydrate altered by age—described by Wittstein as having a crystalline structure. No. 5 is the mineral gothite, and also the dried oxyhydrate commonly used in pharmacy. No. 6 is turgite, hydro-hæmatite, or the mineral from Salisbury, Conn., analysed by Brush and Rodman. No. 7 represents two molecules of ferric oxide.

ON THE

RESOLUTION OF THE SOUNDING FLAME.*

By Prof. FRANCIS H. SMITH.

By those who have no mirrors, lenses, or revolving apparatus, and who find a difficulty in properly moving the eyes to and fro before the flame, the intermittent character of the latter, when sounding, may be exhibited by simply shaking a chalk crayon near it, and noting the marked change assumed in the appearance when the flame passes from silence to song.

With a revolving apparatus, however, the following form of experiment will be found satisfactory:—To the margin of a blackened disc of cardboard was cemented a silvered glass bead. This was set into rapid rotation in a dark room, and in close proximity to the flame in the glass tube. While the flame was silent, there was presented to the eye fixed upon the revolving bead a complete luminous circle, which, when the flame began its song, was broken up into detached beads of light. By increasing the velocity of the disc, these brilliant points, or lumps, were reduced in number, and stretched into separated luminous arcs. The tube used was 3 feet long, and it was found possible to secure such a speed as to have only five luminous arcs. If the revolving mechanism be furnished with a counter or register, like the syren, we have here a simple and ready method of determining the number of vibrations per second of a sounding flame. For this purpose the bead should be light and the disc small. For lecture-room illustration the silvered ball should be large, so as to give a larger image of the flame and a more voluminous bright circle.

To illustrate the use of the method suggested above, let me cite the following measurements:—Employing a glass tube $3\frac{1}{4}$ feet long, with an average diameter of nearly $1\frac{1}{4}$ inches, and keeping the bead whirling so as to present five stationary luminous arcs, the first and second observations gave each 1576·8 rotations of the disc in 43 seconds. The third and last gave 2014·8 rotations in 56 seconds. Giving to each observation the same weight, we have 182·2 vibrations of the sonorous flame per second.

The syren, applied to the same problem, gave 177·7 vibrations per second; but it must be added that I found it impracticable to keep my syren exactly in unison with the flame at so low a note. Beats were heard during almost the entire period (90 seconds) of the experiment.

The note in question, compared with those of a set of excellent tuning forks made by Richie, of Boston, was nearly F.

Again, the luminous arcs were, as nearly as I could judge, about 48° each in extent. This being so, the light of the sounding flame endured *conspicuously* at each pulsation $0^{s}\cdot00366$, or $\frac{1}{273}$ of a second.

It was noticed, too, that each arc varied in brightness, the point of maximum illumination being, not at the centre of the arc, but beyond it; so that it would appear that in each luminous interval, the flame lost its light more rapidly than it acquired it.

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* From a communication to J. D. Dana, dated University of Virginia, Feb. 29, 1868.

I have spoken of the luminous arcs as though they were absolutely detached from each other. So they appear to a careless observer. A close scrutiny, however, revealed an extremely faint and fading thread of bluish light uniting them. Hence, in this case at least, we cannot accept Dr. Tyndall's conjecture that there is an *absolute* extinction, periodically, of the singing flame.

I have applied the revolving silvered ball to the solution of the following problems:—

(1.) *To adjust two sounding flames to exact unison*, or to test the perfection of accord between two apparently unisonant flames.

The revolving ball presented to the two flames, gives two intersecting circles of images, which, in case of exact unison, are equal in number, and present identically the same retrogradations, stations, and advances, during the variable motion of the ball.

(2.) *To determine the exact, or the approximate value of the musical interval between two sounding flames.* Adjusting the velocity of the ball so that each flame gives a circle of *stationary* images (luminous arcs), the relative number of these images will express the interval required. Thus, for one pair of flames, I found the interval to be 2 : 1; for another pair, 4 : 3.

If, when one set of images is stationary, the other set has a slow motion, the relative number of the images will give an approximate value of the interval, the direction of the motion with respect to that of the ball determining whether the value is too large or too small.

For these applications it is obviously unnecessary for the rotating mechanism to be furnished with a register. Indeed a kaleidophone might be used for the same purposes, though with some inconvenience. The silvered balls I have employed vary from half-inch to 2 inches in diameter.

It is scarcely necessary to apprise the readers of this Journal, that the method herein set forth is a simple modification of an experiment devised and described by Prof. W. B. Rogers.*

In the progress of these experiments, it was often noticed that the luminous arcs, or stretched images, of the sonorous flame, were placed in echelon. The reason is manifest, when the silvered ball is revolved slowly and close to the flame. The separate images are then found to be inclined in the direction of revolution, their inclination augmenting with the velocity of the convex mirror, and the slope of the after edge of the image being steeper than that of the front edge. The same tilting of the images occurs, as is well known, in resolving the flame either by Wheatstone's or Tyndall's processes, when the mirror, plane or concave, is rapidly turned. I am not aware that the significance of this fact has attracted attention. Does it not indicate that the flame both recovers and *loses* its light progressively from base to summit, the loss being more rapid than the recovery, and that at no single instant of its history, is the sounding flame such in *size* and *form*, as it appears to be when steadily viewed? Moreover, if the flame, in any case, be rekindled from above, as it must be, if it is ever absolutely extinguished while sounding, it would seem that its image on its first edge at least should be tilted *in a direction opposite to the motion of the mirror*.

I shall conclude these notices by stating a fact bearing upon the theory of these flames. I have found no difficulty in causing the flame to sing when inserted quietly into a horizontal tube, *carefully leveled*. Tubes of various lengths and diameters were used. In narrow horizontal tubes, the vibrations are soon arrested by the accumulating products of combustion. In a tube 1⅜ inches in diam. and 3 feet long, the flame sang for an indefinite time. While it was sounding, no drifting of smoke previously introduced into the tube, or of a column of smoke rising past its distant end, could be detected. It is easy to pass from the ordinary *erect* position of the tube and gas jet, through all grades of inclination to *the inverted position of both, without cessation of the sound*, and without disturbing the *axial* position of the flame.

If by maladroit handling the flame is silenced at the critical attitude, it will be observed that the latter is below the horizontal position.—*Am. Journ. Sci.*, May, 1868.

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* *American Journal of Science*, vol. xxvi, p. 10.

ON THE

ACTION OF FERROCYANIDE OF POTASSIUM ON MONOCHLORACETIC ETHER.

By O. LOEW,

Assistant in the Laboratory of the College of the City of New York.

Kolbe was the first to prepare cyanacetic acid, which is especially interesting from its transformation into malonic acid by treatment with potassa. In a similar manner Heintz prepared sulphocyanacetic acid by boiling monochloracetic ether with sulphocyanide of potassium. This led me to try the action of ferrocyanide of potassium upon monochloracetic ether, to ascertain whether the radical ferrocyanogen can participate, as such, in the reaction. I boiled monochloracetic ether, dissolved in alcohol of 90 per cent, with powdered ferrocyanide of potassium for 4 to 6 hours. An action gradually took place, by which chloride of potassium was formed, together with another light blue amorphous substance, which became of darker colour on exposure to the air, and was undoubtedly Prussian blue.

When the liquid was filtered and boiled with caustic potassa, ammonia was developed; after the latter ceased to be evolved, the liquid was mixed with sulphuric acid and agitated with ether. On evaporating the ether I obtained white crystals, having the appearance of malonic acid. This substance was converted into the lead salt by precipitation with acetate of lead: 0·2997 grm. yielded 0·2904 grm. sulphate of lead = 66·99 per cent Pb. The malonate of lead contains 66·99 per cent Pb.

The reaction is therefore not analogous to that above cited, but the radical ferrocyanogen is broken up into cyanide of potassium and cyanide of iron. The former yields, with chloracetic ether, chloride of potassium and cyanacetic ether, while from the last named body malonic acid is produced.—*Am. Journ. Sci.*, May, 1868.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 18.

Dr. Warren de la Rue, F.R.S., &c., President, in the Chair.

The minutes of the previous meeting were read and confirmed, and several donations to the library acknowledged. Mr. Wm. Hustler, of Falmouth, was formally admitted a Fellow of the Society, and Messrs. H. B. Riddell and S. Alexander Sadler were duly elected. The following gentleman was proposed for election:—W. J. Palmer, M.D., F.R.C.S., Surgeon Bombay Army, and Additional Chemical Examiner to the Government of India.

The President reported the steps taken towards providing superior accommodation for the Society in the new buildings at Burlington House; this statement was well-timed, and appeared necessary in consequence of the front wall in Piccadilly having been parcelled out for sale by public auction. It is understood, however, that the

Italian colonnade will be preserved by special order of the First Commissioner of Her Majesty's Works.

Dr. J. H. **Gladstone** made a statement by way of postscript to his recent paper "*On the Tetraphosphoric Amides.*" When nitrate of silver was added to tetraphosphopentazotic acid, $P_4N_5H_9O_7$, some hydrogen and nitrogen disappeared, and a difficultly soluble salt was formed, containing:—

$$P_4N_4H_4Ag_2O_7.$$

If the acid corresponding to this, viz.:—$P_4N_4H_6O_7$, be taken from the constituents of two atoms of the above pentazotic acid, there remain the elements of another compound, $P_4N_6H_{12}O_7$, which forms with silver a soluble salt. A special experiment, undertaken for the purpose of elucidating this point, gave 151 instead of 162 parts of silver salt from 100 parts of the first-named acid, a result close enough to warrant the assertion put forward by the author in explaining these somewhat complicated changes.

Professor J. A. **Wanklyn** read a paper "*On High Chemical Formulæ—the ground on which they rest: Examples, Mellisic Alcohol, Cerotic Acid, &c.*" The author insists upon the importance of establishing the composition of organic bodies of high formulæ, not only by reference to the method of ultimate analysis, but by studying a wide range of chemical reactions and decompositions. The highest members of the fatty series were selected for criticism by Mr. Wanklyn, who showed that Sir Benjamin Brodie's analyses of mellissic alcohol, published in 1848, led not only to the formula adopted, $C_{30}H_{62}O$, but would stand good for all compounds lying between the terms $C_{28}H_{58}O$ and $C_{37}H_{76}O$, which contain 81·95 and 82·84 per cent of carbon respectively. The theoretical number for the adopted formula being 82·19, and Sir B. Brodie's results ranging, for carbon, from 82·01 to 82·77 per cent. Hydrogen stands within even closer limits of variation, differing only by 0·03 per cent in the two extreme compounds already named. The same remarks were applied to mellissic acid and its silver salt; the analysis of the latter was said to agree equally well with formulæ differing from each other by CH_2, thus:—

C_{29} requires carbon	63·85	C_{30}	64·38
H_{57}		H_{59}	
Ag	19·89	Ag	19·30
O_2..		O_2..	

The author concludes by a recommendation to employ the method of titration of the ether, converting the mellissic alcohol, for instance, into a suitable ether, then liberating the acid, and determining it as a baryta salt. 100 parts of acetate of mellissyl treated in this manner should yield 26·56 parts of acetate of baryta, if its composition be

$$\left.\begin{matrix}C_{30}H_{61}\\C_2H_3O\end{matrix}\right\}O;$$

or 25·81 parts, in the event of its formula being

$$\left.\begin{matrix}C_{31}H_{63}\\C_2H_3O\end{matrix}\right\}O.$$

Professor Wanklyn referred to Berthelot's researches on glycerin as illustrating the advantage of pursuing this line of investigation.

The **President** said he had a clear recollection of the first appearance of Sir Benjamin Brodie's paper on Chinese wax, which was at the time considered to be one of the most masterly treatises in the then comparatively new department of organic chemistry. He could not help regretting that Professor Wanklyn had applied the criticism of modern science to an investigation published twenty years ago, for it should be remembered that the progress of chemistry had made great strides during this interval. Chemists generally were aware that it is difficult to fix the rational formula of a body from the evidence afforded by combustion alone; but, so far as Sir Benjamin's resources enabled him to proceed, there did not then appear to be any direction in which he had not pushed his enquiries.

Dr. **Odling** said it was already well known that the method of ultimate analysis failed altogether in discriminating between bodies containing high proportions of carbon and hydrogen. He did not think that Professor Wanklyn had acted wisely in selecting Sir Benjamin Brodie's investigation for the purpose of this kind of criticism, for whilst he questioned the accuracy of published results he had no fresh evidence to offer. It might happen that the acetate of mellissyl was not easily prepared, and we must then have proof that no disintegration of the alcohol occurred; in fact, for his own part, Dr. Odling considered that the *onus probandi* lies entirely on the other side.

Dr. **Hugo Muller** made enquiry respecting the mode of preparing the acetate, and the criterion by which its perfect purity might be ascertained. If a little of the alcohol were left unattacked, the fusing point would be considerably raised; even in the comparatively simple case of the decomposition of iodide of ethyl by a silver salt a certain amount of destruction always occurred at the outset, and the change did not exactly coincide with the demands of theory.

Professor **Wanklyn**, in reply, would refer his enquirers to Sir Benjamin Brodie's original paper, for an account of the preparation of the acetate. It might be made by passing hydrochloric acid through a solution of the mellissic alcohol in acetic acid. The speaker's object in bringing forward this subject for discussion was to show that the methods of investigation formerly in use did not lead to decisive results, and yet the conclusions were reproduced in the chemical manuals without anything to show that they were not so well established as lower terms in the same series. He would again insist upon the propriety of continuing these investigations in the manner pointed out by Berthelot, notwithstanding the objection and abuse which that author had since had to contend with.

Dr. **Odling** reminded the last speaker that his idol was not altogether infallible, since compounds of glycerin with acids were described, the highest member of which (containing 4 atoms of acid) had subsequently to be withdrawn.

Professor **Wanklyn** said this was no fault of the method, but only an error on the part of the operator, which might with greater care have been avoided.

Dr. W. J. **Palmer** then read a paper "*On the Production of Saltpetre in India,*" which led to an animated discussion on the process of nitrification.

Dr. F. **Guthrie** exhibited "*An Instrument for Maintaining a Constant Temperature,*" where gas is available; and the business of the evening was brought to a conclusion by the reading of some Mineralogical Notices, embracing "*An account of Chalybite, Diallogite, and Woodwardite,*" by Professor A. H. Church, M.A. [Abstracts of these papers will be given next week.]

The meeting being the last of the session was adjourned, at a somewhat late hour, until the first Thursday in November.

CORRESPONDENCE.

ON NUMERICAL FORMULÆ.

To the Editor of the Chemical News.

Sir,—I have found the following plan to be of service as a means of fixing the atomic weights in the memory, and possibly it may be found useful for the like purpose by some of your numerous readers.

With this object in view, I use occasionally formulæ constructed without any letters whatever, the atomic weight of each element being used as its symbol. Between each set of figures a stop is placed; brackets are made use of when requisite, and the number of atoms or molecules entering into any reaction is always represented by a small figure.

I subjoin a few formulæ, and an equation constructed on this plan:—

Hydrochloric acid	$1.35{\cdot}5$
Water	$1_2.16$
Ammonia	$1_3.14$
Marsh-gas	$1_4.12$

The action of iodine on caustic potash is represented thus:—

$$127_6+(1.39{\cdot}1.16)_6=39{\cdot}1.127.16_3+(39{\cdot}1.127)_5+(1_2.16)_3.$$

Or, iodine *plus* caustic potash gives potassium iodate, potassium iodide, and water.

While upon this subject I may mention that the formulæ of compounds of carbon, hydrogen, oxygen, and nitrogen with each other, when required to be written down rapidly, may be conveniently represented by using the figures only which indicate the number of atoms in the ordinary formulæ. Of course the figures must always be written in one and the same order. For example, the first figure may be used to express the number of atoms of carbon; the second, the hydrogen; the third, the oxygen; and the fourth the nitrogen. Should one or more of these elements be wanting, a cipher, or ciphers, may be used to supply its place, and thus indicate the meaning of the following figures.

Formulæ constructed on this last plan are not, as a rule, more than half the length of those in which symbols are used, and may be read by any one with the greatest ease.

In constructing tables containing a large number of formulæ of organic compounds, this omission of the symbols will be found to economise space.—I am, &c.,

John Newlands, F.C.S.

Oberlahnstein, on the Rhine,
June 8th, 1868.

SALT AND RADICAL.

To the Editor of the Chemical News.

Sir,—In continuation of the subject for which you have kindly allowed me space in your journal (No. 443), I beg to make a few remarks upon the meaning of the terms salt and radical. What is a salt?

Although the term salt is in constant use in the text-books, there is perhaps no chemical expression so little understood by schoolboys as this. One would naturally suppose that a word so frequently used possessed some definite meaning; yet the boy who takes up his text-book to find a definition of the word salt would be woefully disappointed, the fact being that at present chemists cannot state clearly, shortly, and concisely what they mean by the word; and hence the absence of any adequate definition, and the present cloudiness of ideas concerning it.

But, Sir, I am fain to believe that if that mischievous substantive "acid" were deprived of all chemical significance, and be used in chemistry only as in common life, to denote an acid taste, just as we use the term sweet, some reasonable, if not absolutely correct definition of the term salt may be arrived at. Something, at least, sufficiently definite to enable the master to teach by, and to satisfy the natural craving of the student for a meaning to the word he is compelled to use.

Before I endeavour to define the term salt, I must ask permission to consider the chemical bearing of the term radical.

1st. Every element is a radical, because it can, without suffering decomposition, enter directly into combination to form a characteristic class of salts. This fact is not broadly and plainly stated in our text-books.

2nd. Although every element is a radical, every radical is not an element. To chemists this assertion may seem self-evident and gratuitous, but we are apparently afraid to make a full admission of the meaning of the word radical in our text-books, and surely we cannot be too plain and simple with beginners.

For all purposes of elementary teaching I would broadly define a radical to be any body that, without itself suffering decomposition, is capable of entering into chemical combination with another.

Further, radicals are either simple or compound, real or imaginary. Simple radicals are the elements; compound radicals are such bodies as Cy, &c.; and imaginary radicals, as SO_4, NO_3, &c., are those which have never been isolated, and, like atoms, only exist in the mind and imagination of the chemist, created for his own use and convenience, but rendering the acquirement of the science by the young much more difficult than it would be without them.

If these views of a radical be correct, a salt will be any compound formed by the union of two or more radicals, and will take its characteristic place and name from the radicals composing it. From this definition it would result that a compound radical is already a salt. If, however, a compound be capable of uniting with another, or taking part in a chemical equation without itself suffering decomposition, it should receive the name radical, compound radical, or salt radical, to distinguish it from a true salt.

Thus HCl, HNO_3, and H_2SO_4, are true salts composed each of more than one radical. If these bodies are salts with a sour taste, let us teach that they are such, and not that they are a special class of chemical compounds capable of generating salts; for radicals, not acids and bases, are the bodies of which salts are composed.

There is, perhaps, nothing more difficult to give than good definitions, and I am well aware that my own are very likely to provoke severe criticism. I trust, however, that the propriety of having something more teachable with regard to the terms commonly used in chemistry, will recommend itself to all, and that whatever my shortcomings may be in this attempt to obtain a general accord as to the terms taught in our schools, and the meanings to be attached to them, my labour will not have been in vain if only something definite be settled upon.—I am, &c.,

Thomas Wood, Ph.D., F.C.S.

Laboratory, 23, Grove Street,
Lisson Grove, N.W.

UTILISATION OF WATER POWER.

To the Editor of the Chemical News.

Sir,—In the Chemical News of September, 1863, appeared a letter from me on the conversion of water or wind power into light and heat by means of magneto-electricity; permit me to give a few considerations as the result of subsequent attention to the subject. The magneto-electric machine is the cheapest known source of electrical power, and would effect an immense saving of coal for lighting purposes. A good and cheap self-acting electric lamp is, however, necessary for this, and attention should be drawn to the subject. Magneto-electric machinery, driven by steam power, would save at least half the coal now used in gas works, while producing more light. Details could be furnished on this point shewing a much greater probable saving than one half.

Magneto-electric machinery driven by water power would, of course, save all the coal used in gas works. There are many districts with reliable water supply in which this great result might be obtained.

On the appearance of Professor Way's mercurial electric-lamp, you showed in a leading article the ease and advantage with which conducting wires might be fixed from a central light-producing magneto-electric factory, along streets and into houses. Would it not be true economy to capitalise some portion of our coal by employing steam power to excavate tidal basins at some of the many suitable points around our coasts for utilising tidal force in driving various forms of machinery, thus exchanging a fleeting for a permanent motive power? The conclusions of Mr. Jevons add force to this suggestion.

Mr. W. M. Durham, in his interesting letter last week, advocates the construction of reservoirs for storing winter floods and storm waters in rivers for motive purposes. The entire subject well deserves attention.—I am, &c.,

G. Alex. Keyworth.

Hastings, June 22nd, 1868.

PS.—As regards economy of fuel, it would be important to know whether the plan suggested, I think by Professor Tyndall, has been tried of covering the boiler and other heated parts of the steam engine with an iron cased lining tightly filled with powdered gypsum. —*G. A. K.*

MISCELLANEOUS.

Death of Mr. Capel Henry Berger, F.C.S.—An inquiry was held on Tuesday evening last by Mr. Richards, deputy coroner, at Sion-house, Lower Clapton, relative to the death from the inhalation of poison of Mr. Capel Henry Berger, aged 28 years. Mr. C. Berrow Berger, Sion-house, said that deceased lived with him, and was a colour manufacturer. He suffered for a fortnight past from a very severe toothache, but a dentist advised him to preserve the tooth and bear the pain. He was an accomplished chemist, and he tried all sorts of things to allay his sufferings. On Sunday last while at church he had to sit in a great draft, and that brought on a relapse of the pain. In the afternoon he went to his room, according to his custom, and bolted himself in for the purpose of spending some time in devotion. When his sister called him down to tea, she could not make him hear, and ultimately witness broke open the door, and found him lying dead on the floor upon some flexible tubing which communicated with a bottle of carbolic acid. His face was quite black, and he had vomited. It was clear that he had died from the carbolic acid, but he had not committed suicide. Dr. J. B. Metcalf said that deceased had fixed an elastic tube, 10 feet long, to a large glass jar of carbolic acid, and had then evidently seated himself in a chair, and had inserted the end of the tube in his mouth, for the purpose of allowing a drop of the liquid to fall on the tooth. He had a brass regulator on the tube to control the quantity of the acid, but it did not act efficiently, and the volatile poison overcame him, and he became giddy and fell. Being alone in the room the poison continued flowing into his mouth, and the heart's action was stopped, and he died. The remedy which he tried was a new one, and the deceased was in the habit of recommending it to his friends. It should never be used without medical assistance. The jury returned a verdict of "Accidental death from inhaling carbolic acid as a cure for the toothache."

Conversion of Mesitylenic Oxide into Mesitylene and $C_{10}H_{14}$.—A. Holtmeyer. Commercial acetone was saturated with chlorhydric acid, the mixture left to itself for a week, and then washed with water. The insoluble portions were dried and distilled, and the fraction boiling between 90° and 100° C. treated with alcoholic potassic hydrate. An oil was thus obtained from which at 128-130° mesitylic oxide distilled off. This oxide, after further purification, was mixed with half its volume of sulphuric acid, and after two days distilled. Two fractions were collected, one at 163-166°, one at 195°. The first was mesitylene—this shows that mesitylic oxide occupies an intermediate position between acetone and mesitylene:—

$$1.\quad \underset{\text{Acetone.}}{2(C_3H_6O)} - H_2O = \underset{\text{Mesitylic oxide.}}{C_6H_{10}O.}$$

$$2.\quad 3(C_6H_{10}O) - 3H_2O = \underset{\text{Mesitylene.}}{2(C_9H_{12}).}$$

The second, a hydrocarbon of the composition $C_{10}H_{14}$. This could be converted into the bromo- and nitro-compounds, $C_{10}H_{12}Br$ and $C_{10}H_{11}(NO_2)_3$; a sulpho acid was also obtained, the baric salt of which corresponded to the formula $(C_{10}H_{13}SO_2O)_2Ba$.—*Ibid.*, N.F., iii., 688.

Venom of Toads.—The Toad, formerly considered as a creature to be feared, does in reality possess a venom capable of killing certain animals and injuring man. This poison is not, as is generally thought, secreted by the mouth: it is a sort of epidemic cutaneous secretion, which acts powerfully if the skin be abraded at the time of contact. Dogs which bite toads, soon give voice to howls of pain. On examination it is found that the palate and tongue are swollen, and a viscous mucus is exuded. Smaller animals coming under the influence of the venom undergo true narcotic poisoning, soon followed by convulsions and death. Experiments made by MM. Gratiolet, Cloez, and Vulpian, show that the matter exuding from the parotid region of the toad becomes poisonous when introduced into the tissues. A tortoise of the species *Testudo Mauritanica*, lamed in the hind foot, was completely paralysed at the end of fifteen days; and the paralysis lasted during several months. Some savages in South America use the acid fluid of the cutaneous glands of the toad instead of the curara. The venom exists in somewhat large quantities on the toad's back. Heated with ether, it dissolves, leaving a residuum; the evaporated solution exhibits oleaginous granules. The residuum contains a toxic powder sufficiently strong, even after complete desiccation, to kill a small bird.—*British Medical Journal.*

Odoriferous principle of Fleur de Garance and Garancine Alcohol.—It is a well known fact, that when ground madder root is prepared into garancine, or fleur de garance, a saccharine liquor is obtained which on fermentation and distillation yields an alcohol which is contaminated with what, for years past, was considered to be methyl alcohol. More recent researches have brought out the fact that the peculiar odour of the alcohol obtained from the washing liquors of the garancine and fleur de garance works is due to acetic ether, and far more largely to aldehyd. The impure madder spirit, as ordinarily met with in trade, is an excellent source from which to prepare and obtain large quantities of aldehyd ammonia by the following method:—From 20 to 30 litres of the impure spirit are placed in a distilling apparatus provided with a long metal (copper) worm, and heated to 60° or 70° C. while at the same time a rapid current of air, or carbonic acid, is passed over the liquid in the still; the distillation is continued until the distillate ceases to give with solution of caustic potash a darkish colouration. To the distillate twice its bulk of water is added, while in order to decompose the acetic ether, finely powdered hydrate of baryta is added with continuous agitation of the liquid until a decided alkaline reaction sets in; the excess of baryta is removed by carbonic acid. The aldehyd is afterwards separated from the liquid by careful distillation on a water bath, and purified by combining it with ammonia. If the impure madder spirit is agitated with sodium amalgam, perfectly pure alcohol is obtained; since the aldehyd is by this means hydrogenised to alcohol, and the acetic ether is decomposed into alcohol, while acetate of soda is formed.

TO CORRESPONDENTS.

Communications have been received from J. H. Freeman, F.C.S. (with enclosure); Dr. J. Attfield (with enclosure); Dr. F.A. Genth (with enclosure); G. W. Wigner (with enclosure); Philip Holland (with enclosure); Messrs. Townsend and Adams (with enclosures); Prof. C. W. Eliot; Beer and Co.; F. C. Calvert and Co. (with enclosure); Dr. R. Angus Smith, F.R.S.; Prof. Heaton (with enclosure); Howard Grubb; J. Newlands (with enclosure); Dr. T. Wood (with enclosure); G. A. Keyworth (with enclosure); P. Le Neve Foster; Bradburn and Co.; W. Bailey and Son; J. L. Denman; W. B. Pinman (with enclosure); J. I. Headley; G. Marrison, Tasmania; Capt. W.A. Ross; Cornish, Bros. H. H. Watson; W. Smith.

Several letters, notices, and papers for publication included in the above acknowledgements are unavoidably postponed till next week

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THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

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IN ALL ITS APPLICATIONS TO

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THE CHEMICAL NEWS.

VOLUME XVIII.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 448.—FRIDAY, JULY 3, 1868.

ON THE
MEASUREMENT OF GASES OVER WATER.
By PHILIP HOLLAND.

Owing to phenomena of absorption and diffusion the category which includes gases capable of measurement over water is a small one. The gas the chemist is most frequently called upon to measure in this way is nitrogen, when making a determination by the method of Dumas.

With regard to this process, I believe I may assert that the experience of those who have had occasion to employ it, is that the errors of experiment is one usually on the side of excess, varying from two- to three-tenths of a per cent, and sometimes more. Our handbooks tell us that the chief source of this inaccuracy is to be ascribed, mainly, to the fact that it is almost an impossibility to chase away all air from the tube at the commencement of the operation, which, however, is expelled at its close: that is to say, when the combustion tube has been heated to redness throughout its length. There is, I consider, another source of error of more or less importance, viz., that the analyst is apt to over-estimate the volume of gas when reading off over water. This is more particularly to be feared when wide tubes are used. In order to remove a possible objection of this kind, I would propose the adoption of the little device of Erdmann,—the glass float which we are so frequently in the habit of employing when measuring fluids; the principle of its application is the same in both cases. The measurement of nitrogen would be conducted as follows:—The graduated tube is nearly filled with water, and inverted in a deep glass vessel. The float, which should be of considerably smaller diameter than the interior of the tube, is allowed to ascend into this latter. Air is next admitted in sufficient quantity to cause the float to take up a position with its line opposite a graduation; the tube is then to be completely submerged, so as to bring the volume of confined air to the temperature of the water. In this state it is to remain whilst the nitrogen is being collected over a solution of potassa. When the combustion is terminated the attention is directed to the measuring tube, which must be raised by means of a wooden holder until the level of the water inside and outside is equal. The graduation must then be read off by means of the float and the number noted; it now remains to transfer the nitrogen in a suitable manner, again to submerge, and note finally the difference of volume.

This difference represents the volume of nitrogen furnished by the substance burnt, and is the one to which the necessary corrections for temperature and atmospheric pressure are to be applied. As regards the complete expulsion of the air from the combustion tube at the commencement of the analysis, I found that a series of experiments made some time ago, in which I took about an equal volume of oxide of copper in each case, gave rather more than a cubic centimetre of unabsorbed gas. A single experiment, made a few days since, gave 1·3 c.c. It was conducted as follows:—Into a tube of the usual length, sealed at one end, was put sufficient dry bicarbonate of soda to fill a space of 6 inches; this was followed by freshly ignited oxide to within 4 inches of the open extremity. A cork and delivery tube were next attached, and the combustion tube placed in the furnace; air was expelled by heating the sealed extremity for some minutes. When the tube was judged to be free from air, the curved end of the delivery tube was passed under the mouth of a cylinder containing a strong solution of potassa, through which the gas was allowed to pass for 15 minutes; at the end of that time the bubble of unabsorbed gas was almost unappreciable. Heat was next applied to the anterior part of the tube, and thence along its whole length. The bubble of unabsorbed gas was measured in a narrow tube over water by means of a float; its volume was found to be 1·3 c.c.

This experiment appears to show that oxide of copper imprisons air between its particles in the process of filling, which is not exchanged for carbonic acid until the oxide is heated to redness. Thinking, therefore, some advantage could be gained by replacing the air originally in the tube by dry carbonic acid previous to filling, the last experiment was repeated with that difference in the conditions. I found, as a result, an advantage as regards the time which elapses before the gas is sufficiently pure to be absorbed by the potassa, but I did not observe any marked reduction in the volume of the bubble.

ON THE
SPECTRUM OF POTASSIUM AND OF BARIUM.
By J. H. FREEMAN, F.C.S.

Of the seventeen lines which constitute the most characteristic part of the Potassium Spectrum, some make their appearance at a lower temperature than others. Now, if a mixture of 10 eqs. of potassic nitrate, 10 eqs. of sulphur, and 3 eqs. of charcoal be ignited, and the light produced analysed by a spectroscope, it will be found that the double line at 130 on Bunsen and Kirchoff's scale, the line at 430, the triple line at 1120, and the line at 3160 will be visible; whilst the triple line at 1300, the triple line at 1530, the triple line at 1760, and the line in the blue will be invisible. But if in the mixture we substitute potassic chlorate for the potassic nitrate, it will be found that all the lines, with the exception of the one in the blue, will come into view. But it is well known that the temperature produced during the combustion of $KClO_3$ and sulphur, is much higher than the temperature of the combustion of KNO_3 and sulphur; and a gradual increase of temperature from that produced by KNO_3 and sulphur, up to that produced by $KClO_3$, may be obtained by gradually abstracting the KNO_3 and supplying $KClO_3$ in its place; so that by gradually increasing the temperature of the combustion, it was found that the order in which the lines made their appearance was.—1st, the line at 130, the line at 430, the triple line at 1120, and the line at 3160; 2nd, the triple line at 1530; 3rd, the triple line at 1300; 4th, the triple line at 1760; but the line in the blue remained invisible when the whole of KNO_3 was abstracted, and its place supplied by $KClO_3$.

The Spectrum of Barium. If a mixture of 10 eqs. of KNO_3, 20 eqs. of sulphur, 3 eqs. of charcoal, and 1 eq. of baric chloride be burnt and the light examined, it will be found that none of the lines of the Barium Spectrum will make their appearance. But when a mixture the same as the one just mentioned, excepting that instead of 10 eqs. of KNO_3 there were 9 eqs. of KNO_3 and 1 eq. of $KClO_3$, was burnt and the light examined, the sharp line at 1330 was visible; but no other. After this a mixture of 8 eqs. of KNO_3 and 2 eqs. of $KClO_3$ with the 20 eqs. of sulphur, 3 eqs. of charcoal, and 1 eq. of baric chloride was burnt, and the line at 1620 and the line at 1730 made their appearance. By gradually increasing the temperature in the way already mentioned, it was found that the order in which the lines made their appearance was—

Line at		Line at	
1330	1st	1840	7th
1730	2nd	830	7th
1620	2nd	990	9th
1780	4th	910	10th
1670	5th	750	11th
1530	5th	1920	12th

Some of these so-called lines are really bands, and when this is the case the central part of the band is referred to on the scale. The spectroscope used had a prism of dense flint glass, with an angle of 60°; and a telescope with a magnifying power of seven diameters. The breadth of the slit, was about ·09 millimetre.

WRITING ON A SCREEN.

By Prof. ALBERT R. LEEDS, of Haverford College, Pa.

Every lecturer has felt how unsatisfactory it is to write or draw, or in any manner attempt to illustrate his ideas in a large room. This difficulty may be overcome in the following manner:—A plate of glass is placed in the limeight or magnesium lantern, and an inverting prism put in he forward part of the draw-tube of the objective. If now, while looking and lecturing to the audience, writing is done with an ordinary pen and indian-ink upon the glass plate, and proceeding from left to right upon the plate, it will advance correspondingly upon the screen, and will be read in greatly enlarged characters by those present. The square prism inverts with respect to bottom, and the writing being actually reversed by the writer in reference to the other direction in which the lantern is pointing, the crossing of he rays produced by the lens becomes in this case an advantage, and corrects the letters upon the screen. A collodion film, blackened by exposure to the sun's rays, may be substituted for a naked glass plate to great advanage. On such a film chemical and mathematical formulæ, drawings of apparatus, machinery, crystals, anatomical delineations, &c., may be cut with the utmost delicacy, and appear as intensely bright white lines on a black ground, and with something of the appearance of an immense copper-plate engraving.—*Am. Journ. Sci.*, May, 868.

ON SUPERSATURATED SALINE SOLUTIONS.

By CHARLES TOMLINSON, F.R.S.

The phenomena presented by supersaturated solutions are of a perplexing character, and have occupied the attention of many inquirers during the last seventy or eighty years. The fundamental fact on which the subject rests is sufficiently remarkable, namely, that a strong, hot solution of a salt such as that of sodic sulphate, which, in cooling in an open vessel soon begins to deposit crystals, should, in a closed vessel, retain the salt in solution at ordinary atmospheric temperatures, and so become supersaturated, that is, capable of holding a much larger quantity of salt than the water could take up at the reduced temperature. Gay Lussac referred the state of supersaturation to the inertia of the saline molecules, as well as to the molecular condition of the sides of the vessel. Löwel, after an elaborate inquiry extending over many years, arrived at the conclusion that the state of supersaturation is one in appearance only, and not in fact; that a solution of the ordinary decahydrated sodic sulphate, for example, saturated at the boiling point, and cooling down in a closed vessel to about 60° F., changes its molecular condition into one of a more soluble salt, namely, the heptahydrated; that on a further reduction of temperature, crystals of the modified, or seven-watered salt, are deposited at the bottom of the solution. If, however, the vessel be opened, or the solution touched with an active nucleus, it instantly recovers the molecular condition of the ten-watered salt and becomes solid. As to the action of the air and other nuclei, Löwel regards it as "the effect of one of those mysterious contact actions, known as *catalytic*, of which science has not yet been able to give a satisfactory explanation."

Löwel's theory, respecting the molecular change of the solution and the increased solubility of the modified salt, has been generally accepted as a satisfactory explanation of the existence of supersaturated solutions. Such being the case, later inquirers have chiefly directed their attention to the action of nuclei. We have noticed their researches on several occasions. M. Gernez,[*] for example, examined not fewer than 220 substances in his endeavour to find some law of action for nuclei. He also extended his researches to supersaturated gaseous solutions,[†] such as soda water, champagne, &c. His explanation of the latter class of phenomena was combated by Mr. Tomlinson,[‡] who started a new theory and supported it by a number of decisive experiments. In a paper read before the Royal Society, on the 28th of May last,[‖] Mr. Tomlinson amplifies and extends this theory to supersaturated saline solutions. He also combats Löwel's views as to the molecular change that leads to the formation of a more soluble modified salt, and substitutes an entirely new theory, supported by experiments, to account for the formation of the modified salt.

We propose to give a short account of Mr. Tomlinson's theory, if it is possible to be shorter than the necessarily brief abstract published in the Proceedings.

As to the action of solids as nuclei, Mr. Tomlinson distinguishes between those that are chemically clean and those that are not clean, or only clean in the ordinary sense of the word. If a vessel containing a supersaturated solution, say of Glauber salt or of Epsom salts, be made chemically clean by a previous washing in strong sulphuric acid, or in spirits of wine, or in caustic alkali, the solution adheres to it as a whole, and there is no separation of the salt at ordinary temperatures. So, also, if a glass rod, or other solid nucleus, be made chemically clean and placed in the solution, there is the same perfect adhesion between it and the solution, and it does not produce any separation of the salt. If, however, the interior of the vessel or the glass rod be not chemically clean, there is a stronger adhesion between the salt and the unclean surface than between the water of the solution and the salt, or between the water of the solution and such surface, and there will be a separation of the salt; and the action thus once begun will be propagated rapidly throughout the liquid until, in strong solutions, the whole becomes solid. In such a case the rise in temperature may be considerable; in the case of the sodic acetate it was as much as 90° or 100° F.

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[*] See Chemical News, xi., 250, 289.

[†] *Ibid*, xiv., 260.

[‡] *Ibid*, xvi., 54, 149.

[‖] Proceedings of the Royal Society xvi., 403.

It is remarkable that if strict attention be paid to chemical purity, highly charged supersaturated solutions, including that of the sodic sulphate, may be cooled down to 10° F., or lower, without any separation of the salt. Hence Mr. Tomlinson denies that any molecular change takes place in the solution of sodic sulphate when the temperature falls below 60°, as Löwel supposed. Many of Löwel's results were probably due to want of purity in the sides of his vessels, and to his practice of closing his flasks with corks, instead of simply plugging them with cotton wool. When corks are used a rarified atmosphere is formed above the solution during the cooling, and the air often finds its way in, dragging with it a solid mote or particle of dust, which acts as a nucleus; whereas, with a cotton wool plug, the air regains admission as the solution cools, and the wool keeps back dust and motes. The air itself is not a nucleus, for a solution in a clean stoppered bottle, only one-third or one-half full, may be violently shaken, and the air thoroughly incorporated with the solution, without any separation of salt; but when the stopper is removed, the solution immediately becomes solid. Hence, when air appears to act as a nucleus, it is only as a carrier of some mote or particle of dust that acts as a nucleus; and this explains the curious facts, observed by previous enquirers, that supersaturated solutions can be kept longest in narrow-necked open vessels than in wide ones, because in the one there is less chance of a mote falling in than in the other. When a solution does not crystallise on taking out the plug, it may often be started by scratching the inside with a wire not chemically clean (if chemically clean it will produce no effect). The lines scratched on the interior of the flask, though invisible at first, are chemically unclean, and are immediately filled up with minute crystals, and the action, once started, continues. So, also, if a strong and hot solution be filtered into a chemically clean flask, and, before closing it, the upper part of the inside be touched with the finger slightly greasy, the solution will cool down and remain supersaturated; but if the flask be inclined, so as to touch the unclean portion, crystallisation immediately sets in.

A liquid, such as spirits of wine, acts as a nucleus indirectly, by combining with a portion of the water of the solution, and setting free a portion of the salt. This starts the crystallisation, and the action, once begun, continues. Hence, in many cases of supersaturated solutions prepared with distilled water, boiled and carefully filtered into chemically clean vessels, there is nothing to start crystallisation, and such solutions may be kept any length of time, or even put into freezing mixtures at 10° F., or from that to 0°, without any separation of the salt. Supersaturated solutions of the sodic sulphate, acetate, arseniate, succinate, and borate were treated in this way; as also of Rochelle salt, potash alum, Epsom salts, and some others. In other cases the supersaturated solutions, at low temperatures, suddenly solidified, as in the case of the sodic carbonate and phosphate, the plumbic acetate, and some others. Other solutions deposit their excess of salt at low temperatures, or under the action of a nucleus, leaving the mother liquor saturated; such are the zinco-acetate, the cupric sulphate, baric chloride, citric acid, and some others.

Seeing then that many highly charged supersaturated solutions,[*] if proper precautions be taken to insure chemical purity, can be reduced to low temperatures without crystallising, Mr. Tomlinson contends that supersaturation exists in fact, as well as in appearance, and that there is no proof of any molecular change in such solutions, such as to lead to the formation of a more soluble salt which forms only a saturated solution on account of its greater solubility. Such a view of the case is mere theory unsupported by experiment. But then it may be asked "How does Mr. Tomlinson account for the seven-atom hydrate in the case of the sodic sulphate, and which is found only in supersaturated solutions?"

The answer to this question is stated very clearly. The ordinary sodic sulphate, which crystallises with ten atoms of water, parts with this water so easily by mere exposure to the air or under a gentle heat, that there can be no doubt that when placed in hot water, it is the anhydrous salt that enters into solution. Now when such a solution (2 salt to 1 water) is reduced to a temperature sufficiently low, it deposits a portion of the salt it can no longer hold at the reduced temperature. But the salt thus deposited is not the ten-atom hydrate, nor the seven-atom hydrate, but it is the anhydrous salt in octohedral crystals, the hydrates being in prisms, the one with dihedral and the other with oblique summits. Now if the tube be set aside or even be left in the freezing mixture, as the temperature rises these anhydrous crystals enter into solution and form a dense lower stratum, containing only water enough for the seven-atom hydrate, and accordingly this salt forms at the bottom of the vessel in small quantity, while the remainder of the solution that rests upon it, is still supersaturated. If now the tube be opened, crystallisation will set in from the surface, where there is plenty of water, and the crystals dart rapidly down, carrying with them, not only enough water to form the ten-atom hydrate, but also enough to convert the seven-atom into the ten-atom hydrate, a change which is marked by the dead white opacity that comes over the modified salt.

The formation of the modified salt may be conveniently studied in the case of zinco sulphate. When a saturated solution of this salt cools down from the boiling point to about 70°, an anhydrous or monohydrated salt is thrown down in quantity, and as the solution cools a portion of this dissolves, and a crop of acicular crystals is produced. This is a modified salt formed at the bottom, very different from the ordinary six-atom hydrate which forms at the surface as soon as the plug is removed. The ammonia-phosphate also forms a modified salt. The strontia nitrate also deposits an anhydrous salt in cooling down to about 62°; but as this is not soluble in the solution, the modified salt is not produced.

M. Löwel points out modified salts in the case of the sodic carbonate and the magnesia sulphate; but as he attaches great importance to the peculiar catalytic properties of the sides of his vessels in determining the formation of these salts, Mr. Tomlinson supposes M. Löwel's results were due to portions of the sides of his vessels, not chemically clean, acting as nuclei. In chemically clean vessels M. Löwel's results were not produced. The sodic carbonate solution suddenly became solid in reducing the temperature; while the magnesia sulphate solution resisted a cold of 10° F. and under.

The conclusions arrived at by Mr. Tomlinson are—(1), that a number of hydrated salts form supersaturated solutions and remain so even at low temperatures simply from the absence of a nucleus to start the crystallisation. (2). That a nucleus is a body that has a stronger adhesion for the salt than for the water which holds the salt in solution, a state of things brought about by the absence of chemical purity. (3) That three or four salts form supersaturated solutions which in cooling down deposit a modified salt or one of a lower degree of hydration than the normal salts. (4). That this modified salt is formed first by the deposit, in small quantity, of the anhydrous salt, which entering into solution, forms a dense lower stratum containing less water than the rest of the solution, in which lower stratum, the modified salt, is formed. (5). That salts of a low degree of hydration form supersaturated solutions, which on reduction of temperature, or, by the action of a nucleus, deposit the excess of salt that held the solutions supersaturated, leaving them merely saturated.

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[*] Some idea may be formed of the extent of supersaturation from the fact stated by Mr. Tomlinson in the discussion on his paper, that some solutions at low temperatures contain from 60 to 90 times more salt than the water could take up at those temperatures, and that without any separation of the salt.

We venture to think that if these conclusions are substantiated, the whole subject of supersaturation is definitely settled.

It has often been stated that certain anhydrous salts, such as nitre and potassic bichromate form supersaturated solutions. Mr. Tomlinson arrives at an opposite conclusion. His method of testing this point was to make a solution of known strength as indicated by some good Table of solubilities, raise it to the boiling point, and then note whether any salt was thrown down when the solution reached the temperature indicated by the table. Thus, according to Gay Lussac's table, 100 parts of water at 150° F. contain in a saturated solution, 125 of potassic nitrate. A solution of 125 parts salt in 100 of water, in a chemically clean flask, with a clean thermometer passing through the cotton wool plug, sank from the boiling point to 149°, when it began to deposit salt. The deposit first appeared on the side nearest the window, or the coldest side, when the flask was suspended in air; but if the flask were placed on metal or other good conductor, a ring of salt was first formed at the bottom 6° or 8° earlier than when the flask stood on a block of wood.

According to Kremer 200 of water at 140° F. dissolve 100 parts of potassic bichromate. Such a solution in cooling from the boiling point began to throw down crystalline flakes at 138°.

Many other solutions were tried, and the conclusion is that anhydrous salts do not form supersaturated solutions.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 18.

Dr. Warren de la Rue, F.R.S., &c., President, in the Chair.

In continuation of our report of this evening's proceedings we now give abstracts of the three communications which concluded the business of the session.

Dr. W. J. **Palmer** contributed an interesting narrative entitled "*Observations on the Production of Nitre in India.*" The native "sorawallahs" make it the business of their lives to search for saline incrustations in and around the mud walls which enclose the primitive dwellings of the inhabitants of the north-western provinces of India. When the appearance of the soil indicates the existence of nitre they scrape off a thin layer of the impregnated earth and lixiviate it in clay vessels either with water alone or with the last washings of a previous operation, the solution thus obtained being poured into shallow pans of unglazed earthenware, and there left exposed to the sun and hot winds of a tropical climate, until the nitre crystallises out. The crude product is then partially purified by being again dissolved and recrystallised. The saltpetre is recovered in the form of dingy prismatic crystals, and common salt to the amount of from one to nine per cent is left in the mother liquors, which upon evaporation to dryness is recovered and separately collected. The sorawallah makes periodical visits and secures fresh collections of nitre from the same spots of ground week after week, the rate of production remaining constant whilst the dwellings are inhabited, but decreasing gradually if from any cause the villages are deserted. The physical features of the nitre-producing regions were then described, and the author referred to the conditions under which most nitre seemed to be obtained; these were dependent upon the existence in the plains of India of a friable, nodular, calcareous rock called "kunkur," and water must not occur nearer the surface than twenty feet; but it was remarked that the largest yield of nitre was furnished in the four months of the year constituting the rainy season, the heavy tropical rains having the effect of washing the salt from the depths of the soil to the surface rather than of dissolving it out entirely and carrying it into the rivers. The process of nitrification commenced with the conversion of urea, &c., into nitrate of lime, under the combined influences of heat, moisture, and of the before-mentioned calcareous rock; whilst the practice of the natives of throwing their wood ashes into the common drains supplied the carbonate of potash from which, by double decomposition, the nitre was formed. These changes only occur in the neighbourhood of villages, or densely populated localities, but the process of artificial generation of saltpetre had been successfully carried out in connexion with the Indian jails. The author adds a speculation as to the influence of electrical agencies (thunderstorms) in contributing towards a more rapid formation of saltpetre.

The **President**, in proposing a vote of thanks to Dr. Palmer, invited discussion upon the electrical theory of the generation of nitric acid; whether all other circumstances being the same, most nitre should be formed during the season in which thunderstorms were prevalent.

Mr. W. H. **Perkin** expressed his surprise in noticing how few sparks from a Rühmkorff coil sufficed to produce red fumes in a jar of air, especially if the temperature was somewhat raised, and the indigo test at once showed the presence of nitric acid.

Mr. David **Forbes** had had opportunities of studying the saltpetre manufacture in several parts of the world. In order to ensure a supply of saltpetre in case of war, in Sweden, every peasant was bound to supply a certain amount of nitre to the Government as part payment of the taxes. It was the practice to rely upon wood ashes from the household fires as the source of potash, the other ingredients being nearly the same as in India, with lime added where it did not occur naturally. In the cold climate of that northern latitude there was no suspicion of lightning having any direct influence upon the generation of nitric acid. Spain formerly got much saltpetre from the plains of the south, where nitrogenous organic matter was somewhat scarce, but potash abundant, as the result of the decomposition of the felspar of the granites. In Peru, Chili, and other parts of the continent of South America, where rain *never* falls, immense accumulations of nitrate of soda were known to exist; in fact, it appeared only necessary to place organic matter in contact with carbonate of lime and common salt to secure the production of the nitrate of soda or Chilian saltpetre in that climate, and in these districts all the wells were so fully charged with saline matter, that it was necessary to procure water distilled from the sea with English coal at the cost of £3 or £4 per ton for ordinary household use; even the locomotives on some South American lines had to be supplied with distilled water to avoid the formation of saline crusts in the boilers.

Dr. J. H. **Gilbert** was led to believe that the process of nitrification was practically independent of the oxidation of atmospheric nitrogen or of electrical action: some years ago he searched for ammonia and nitric acid in rain water which fell during a heavy thunderstorm, and found ammonia without difficulty, but the quantity of nitric acid was excessively small.

Mr. John **Williams** took occasion to examine for *sulphuric* acid and ammonia in the rain water which fell during the thunderstorm in London about the end of May. The Nessler test immediately indicated the presence of ammonia, and the amount of sulphuric acid was by no means inconsiderable.

Dr. Hugo **Muller** said it was well known that organic matter containing but little nitrogen furnished nitrate as the result of its putrescence, and it had been hinted that the oxidation of these organic matters was capable of inducing (by a sort of catalytic action) the formation of nitric acid from the surrounding atmospheric nitrogen. Schönbien proved that nitric acid was formed merely by bringing nitrogen gas in contact with flame.

Dr. **Guthrie** was desirous of assuring himself that the proceeds of the sale of nitre more than covered the cost of production under favourable circumstances of native labour. Some years ago he proposed to the Government authorities to collect saltpetre in the Mauritius, for the town lies low and near the sea, and there were difficulties in the way of securing good drainage. Not only as a commercial speculation, but as a sanitary measure, the removal of this sewage, and the conversion of it, if possible, into saltpetre seemed to be important; his advice was not adopted, and since that time his views had received confirmation by the fearful ravages of disease and high rate of mortality which had occurred in the island.

Dr. J. **Attfield** conceived that the largest production of nitre would not coincide with the periods when thunderstorms most frequently succeeded each other, but that a necessary interval must elapse to allow time for the oxidation to proceed.

Dr. **Odling** referred to an anomaly in the fact that starch paste, although destitute of nitrogen, gave off ammonia during its fermentation. For his own information he enquired whether the great bulk of nitre imported from India is made by the manurial collection plan which had just now been described?

Dr. **Palmer** supplemented his previous remarks by making a few statements respecting the depth at which water ordinarily occurred in the large tracts of country near the Himalayas as compared with other localities in the plains of the Ganges. There could be no doubt about the fact that nitre was collected in much greater quantity during the four months of the rainy season than at other times, but whether this circumstance was due to the more speedy recovery of the salt, already formed, by the solvent action of water resulting from heavy rains penetrating the earth to a greater depth, and by subsequent evaporation becoming reabsorbed to the surface; or to a direct influence of electrical action in promoting the nitrification, seemed to him (the speaker) well worthy of discussion, and he was only glad to have started a subject of so much interest to the members of the Society. For his own part he now thought that the lightning had very little influence in contributing to the formation of saltpetre. In reply to Dr. Odling he would state that all the saltpetre which came to England was the produce of the small collections brought in by the "Sorawallahs," who for centuries past and for many succeeding generations had carried on this business in the Bengal provinces.

Dr. F. **Guthrie** exhibited and described a little "*Instrument for Maintaining a Constant Temperature,*" where gas is available. It consists of a bulb containing air connected by an elbow-piece to an upright glass tube filled with mercury, the column of which rises to a greater height when the air in the bulb suffers expansion by heat. The ascent of the mercury is used to cut off partially the communication between the gas burner and its supply; it does this merely by rising into the bend of a U-tube, through which the gas is conducted. The whole apparatus admits of adjustment for use at any required temperature by depressing an iron wire piston into the mercury reservoir. The position of this sliding piston may either be central or extra-lateral.

Mr. **Herbert McLeod** instituted a comparison between this instrument and Bunsen's thermostat; and Dr. E. J. **Mills** mentioned some points of similarity to Kemp's gas regulator. A form of instrument sketched in Greville Williams's *Chemical Manipulation* was likewise referred to.

The **Secretary** then read some *Mineralogical Notices*, by Professor A. H. Church, M.A., which included descriptions and analyses of chalybite, diallogite, and woodwardite.

I. *Chalybite.*—The sample examined was found by Mr. Wm. Vicary, F.G.S., as a globular mass in the interior of a large flint from Haldon, near Exeter. It was crystalline with radiated structure, and yellowish grey in colour. Upon analysis it proved to be almost chemically pure ferrous carbonate, and the iron determined by the permanganate method gave nearly the theoretical proportion.

II. *Diallogite.*—A pale rose-red variety, of exceptional purity, obtained from Mr. Talling, of Cornwall. It furnished, on analysis, results indicating the following composition:—

Carbonate of manganese	97·65
Carbonate of iron	2·65
	100·30

III. *Woodwardite.*—The author answers the objections of M. Pisani (*Comptes Rendus*, 1867, p. 1142), who believes this mineral to be a mixture of langite and allophane, by asserting that clean specimens of woodwardite do not contain so much as 1 per cent of silica, and that they exhibit sufficiently definite chemical and physical characters to justify their being considered a distinct mineral species. Viewed under the microscope, the mineral appeared to be of uniform structure throughout, which is not the case with the samples analysed by M. Pisani, nor with those of an olive-green colour previously examined by Messrs. Church and Warington, to which they hesitated to assign a formula. The analytical results of this obviously-mixed specimen are now published, for comparison with the numbers stated in the *Comptes Rendus.*

Mr. **David Forbes** complained that chemists frequently omitted to give the specific gravity, and other physical characters of great importance, in deciding the claims of a mineral to be considered a new species.

Dr. **Hugo Muller** considered the mode of occurrence in the mine a matter of greater consequence than had been usually allowed. With many of these Cornish minerals the exact locality and mode of occurrence were kept a profound secret, and samples obtained from the dealers might frequently give concordant results on analysis, merely from the circumstance that they were all portions of the same mineral slab.

Mr. **Wm. Hustler** said he had great doubts about the existence of woodwardite as a distinct mineral.

Mr. R. **Warington** defended woodwardite, on the ground of all the analyses showing a general agreement. The chemist had but small chance of tracing the origin of a mineral in the mine.

The **President**, after moving a vote of thanks in favour of the respective authors, adjourned the meeting until the first Thursday in November.

FOREIGN SCIENCE.

PARIS, JULY 1, 1868.

Method of analysing commercial acetate of lime.—Estimation of iodine in the residues of the aniline colour factories.—Constitution of iodide of starch.—New process for the manufacture of white lead. Preservation of ferments.—Employment of phosphide of zinc in therapeutics. Academy of Sciences: Researches on the salts of thallium.—Action of the voltaic arc on the earthy oxides.—Nitroprussiate of potash as a test for alkalinity.—Production of the diamond.

M. **Fresenius** has proposed a new method of effecting analyses of commercial acetate of lime. The ordinary process consists in estimating the acetic acid by difference, after calcining the acetate; since the commercial product always contains tar and other impurities, the process is inaccurate. The method adopted by M. Fresenius is the following: 5 grammes of the acetate to be examined are introduced into a retort with 50 c.c. of water and 50 c.c. of phosphoric acid of 1·2 density, and free from nitric acid. The mixture is distilled with care to dryness, 50 c.c. of water are then added and the distillation repeated. The operation having been made a third time, the distillates are united, and diluted to 250 c.c.; 50 c.c. are then taken for a titration with standard soda solution. It is not necessary to search for hydrochloric acid in the distillate, for the amount of this acid can be ascertained after the titration by means of standard nitrate of silver.

The same eminent chemist has also made known a method of estimating iodine in the residues from the manufacture of aniline colours. There are now found in commerce mother liquors worked for the manufacture of iodine, and containing besides this metalloid, sensible quantities of alkaline arseniates and arsenites, as well as organic matter. These waters occur in the manufacture of aniline colours; their value depends upon the amount of iodine they contain, the amount of this metalloid and the proportion engaged in the organic matter are therefore the two things that are required. The following is the process: 10 grammes of liquid are treated with 2 grammes of potash in concentrated solution, the mixture is then evaporated to dryness in a chimney with a good draft, or in the open air, on account of the cacodylic products occasioned, and ignited ultimately. The aqueous solution of the residue is made up to 250 c.c., of which 20 c.c. are treated by a mixture of sulphuric and hyponitric acids. The iodine from the 20 c.c. is separated by agitating with sulphide of carbon; as the sulphide of carbon solution may be acid, it is necessary to agitate with water until the washings no longer affect litmus paper; when this is attained, a titration is made with hyposulphite of soda.

Iodide of starch has been subjected to an examination by M. Guichard. Since its discovery, the constitution of this body has been often discussed; according to some chemists it is only a mixture of iodine and starch, or starch tinted by iodine, others on the contrary consider iodide of starch to be a definite combination of iodine and starch, with excess of iodine. The general opinion is that the iodide of starch is a simple mixture, and the colourless iodide is only starch with hydriodic acid. M. Guichard thought that an examination with the dialyser would throw light upon the question. If there existed, in fact, a combination of iodine and starch, the compound ought to be colloidal, and remain in the dialyser; if, on the contrary, only dissolved iodine and hydriodic acid were there, starch would alone remain. M. Guichard made a great number of experiments, he remarked that iodine passed the dialyser first, then hydriodic acid in large quantity, afterwards the iodide became suddenly decolourised, and later the iodine, as well as the hydriodic acid, ceased to be disengaged. When the experiment was made with iodide of starch decolourised by heat, the disengagement of iodine was difficult to perceive, that of hydriodic acid was alone observed; the same was the case with the iodide heated in close vessels for some hours to 100°, then to 150°. The colourless iodide of starch has then no existence; the so-called iodide of starch is simply starch tinted by iodine. Heat thus separates the iodine from the starch; the iodine then remains in the water, either as such or as hydriodic acid.

M. A. Girard has recently invented a new process for the manufacture of white lead. The lead is first prepared for treatment by granulating it; the granulated metal is placed in a rotating cask (which should be made of beech or elm, not oak) with one-fourth its weight of pure water. The cask is made to rotate at the rate of thirty or forty turns a minute, and arrangements are made for the passage of a current of air during the rotation. After about two hours, nearly the whole of the lead is found to be oxidised, and then carbonic acid is introduced in the place of the current of air, and the rotation continued for four or five hours further. At the end of this time nearly the whole of the lead is found to be converted into hydrated carbonate, fine white lead, which can be separated from all the metal remaining intact by decantation.

At a meeting of the *Société de Pharmacie*, M. Mialhe gave an account of his researches on the preservation of ferments. The conclusion to be drawn from these researches is, that physiological ferments can retain indefinitely their action when suitably dried. This fact confirms the assertion of Rouchoux relative to the activity of dry vaccine lymph, and Mangili's relative to the dried poison of the snake.

M. Vigier read at the same meeting a communication on the therapeutic employment of phosphide of zinc, by M. Curie and himself. The phosphuretted preparations in use, he said, offer such great inconveniences as to create a serious obstacle to the employment of phosphorus in therapeutics; they are either repugnant to the taste, or uncertain. Phosphide of zinc, on the contrary, unites the conditions of an excellent medicament, and seems destined to replace all the other preparations of phosphorus: it is a grey crystalline substance, perfectly definite, unalterable in moist air, and still decomposed by the juices of the stomach. This phosphide produces in animals poisoned by it the same effects as phosphorus—alteration of the blood, congestion of the lungs, paralysis of the heart, alteration in the cells of the liver, &c.

The following is a list of the memoirs of chemical interest communicated to the Academy of Sciences at the *séance* of the 8th inst., "Chemical, Optical, and Crystallographic Researches on the Salts of Thallium," by MM. Lamy and Des Cloizeau; "Action of the Voltaic Arc on the Earthy Oxides," by M. Le Roux; "On the Compression of Saturated Vapours," by M. Cazin; "On the Employment of Nitroprussiate of Potash as a Test for Alkalinity," by M. Filhol; "On Chloropropionic Acid," by M. Buchanan; "On the Production of the Diamond," by M. Saix, by the same author a note entitled "Theory of the Pile, its laws;" a note in reference to the principle of a new electromoter founded upon inductive electricity; "A Note on the Water of the Mediterranean, the Water of the Ports of Marseilles, and the Gases disengaged from the latter," by M. Commaille, completes the list.

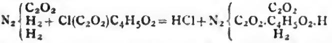
It is well known that nitroprussiate of potash can serve to distinguish a solution containing free hydrosulphuric acid from a solution of an alkaline sulphide; while hydrosulphuric acid undergoes no apparent change when mixed with a solution of nitroprussiate of potash, a solution of an alkaline sulphide thus treated, becomes coloured, immediately, deep blue or violet. M. Béchamp has proposed to employ nitroprussiate of potash as a reagent to distinguish mineral waters in which the sulphur occurs as hydrosulphuric acid from those containing a sulphide. MM. Mialhe and Lefort in investigating the chemical composition of some warm waters have had recourse to this reagent to determine the state in which the sulphur existed in these mineral waters. The great alterability of the waters of certain mineral springs, the facility with which they evolved a relatively large quantity of sulphur in the state of hydrosulphuric acid, had impressed M. Filhol with the idea that they contained sulphide of calcium. He had therefore attempted the use of nitroprussiate of potash, but difficulties here occurred, which led him to examine carefully the action of this reagent upon certain solutions, and to observe that a mixture of nitroprussiate and hydrosulphuric acids constituted a reagent of great sensibility for the detection of alkalinity in any solution. Such a mixture is not only coloured by the presence of caustic alkalies, but also under the influence of alkaline carbonates, bicarbonates, borates, or silicates; it becomes coloured likewise a very intense blue, when phosphate of soda, or any other salt having an alkaline action upon litmus tincture is present. M. Filhol remarks that to see hydrosulphuric acid act upon a solution of phosphate of soda so as to produce sulphide of sodium is certainly curious. Nitroprussiate of potash thus is shown to be a reagent, permitting of the discovery of the phenomena of decomposition, which takes place between an acid and a salt in solutions where all the products of the reaction remain dissolved. These facts evidently have interest also in regard to the study of sulphurous waters, either natural or artificial. It would be no longer permitted now to say that a mineral water only contained hydrosulphuric acid in the free state, if at the same time this water contained alkaline carbonates, borates, silicates, and phosphates. A more or less considerable quantity of sulphide in fact is produced when these salts are mixed with hydrosulphuric acid. In examining the waters of the Ax (Airége) with nitroprussiate of potash, M. Filhol was surprised to see the water from the warmest springs (temp. 75° to 76° C.) behave like a solution of free hydrosulphuric acid, when he had a multitude of reasons to suppose that the water contained an alkaline sulphide in solution. Not less surprised was he to find the same mineral water cooled out of contact with the air, behave with the nitroprussiate as a solution of an alkaline sulphide. We may expect some further details.

M. Saix indicates, in his memoir "Upon the Production of the Diamond," a process which he believes could be employed for the "manufacture of black, coloured, and colourless diamonds." This process is founded on the principle that a current of chlorine, or of hydrochloric acid gas, passing over fused cast-iron, forms perchloride or protochloride of iron, both of which volatilise, leaving the carbon present in the mineral intact, since the chlorine ought not to unite directly with the carbon. The crystallisation of the carbon could thus be effected, according to the author, following the general rule, for crystallisation is produced in a solution of a substance susceptible of crystallisation whenever the solution is evaporated. The size of the crystals depends always upon the slowness of the evaporation. Your readers will doubtless praise the disinterestedness of a savant who thus leaves others to gather the golden apples.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Preparation of Carbonic Oxychloride.—Th. Wilm and G. Wischin recommend the following as the most convenient method for preparing phosgen gas:—Pure carbonic oxide and chlorine are conducted through a properly perforated india-rubber stopper into a flask of white glass of about 10 litres capacity, the tubes reaching to the bottom of the flask. The mixed gases then pass through a third shorter tube to the bottom of a second, and from there to a third flask of similar sizes. The gas issuing from the last is free from chlorine, and contains only traces of carbonic oxide, if the two gases, as is advisable, enter the first flask in such proportions that the volume of carbonic oxide is slightly in excess. The operation has, of course, to be performed in sunlight.—*(Zeitschr. Chem.*, N.F., iv., 5).

Synthesis of the Ether of Allophanic Acid.—Th. Wilm and G. Wischin.—On heating equal eqs. of urea and ethylic chlorocarbonate in a small flask connected with a reversed Liebig's condenser, the ethylic allophanate of Liebig and Wöhler is formed, from which synthesis the authors conclude that this body is urea, in which 1 atom of H is substituted by the monovalent group $C_2O_2.C_4H_5O_2$:—



$$N_2\left\{\begin{matrix}C_2O_2\\H_2\\H_2\end{matrix}\right. + Cl(C_2O_2)C_4H_5O_2 = HCl + N_2\left\{\begin{matrix}C_2O_2\\C_2O_2.C_4H_5O_2.H\\H_2\end{matrix}\right.$$

In a note to this communication, Kolbe adds that this ether of allophanic acid might be considered as carbaminic ethide in which amide is replaced by urea minus 1 atom of hydrogen.—*(Ibid*, 5).

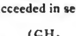
Reduction of Indigo-Blue.—A. Baeyer.—Indol may be obtained directly from indigo by treating the latter with tin and chlorhydric acid. A green substance, a compound of indigo-white with suboxide of tin, is first formed, which on continued heating becomes yellow, being converted into a compound of tin with a further reduced indigo-blue. This yellow compound, mixed with little water and powdered zinc, when heated gives out indol in large quantities. Indigo-blue may be considered as composed of two molecules of indol joined together by two atoms of oxygen—$(C_6H_4C_2HN)_2\Theta_2$. During the reduction to indigo-white one atom of oxygen is taken out, and the compound $(C_6H_4C_2NH.\Theta H)\Theta(C_6H_4C_2NH_2)$ formed. Further reduction removes the second atom of oxygen, the two molecules separate, and an isomer of oxindol, $C_6H_4(C_2NH_2.\Theta H)$, is obtained.—*(Deut. Chem. Ges. Berlin*, 1868, 17).

Determination of Sulphur in Organic Compounds.—R. Otto determines sulphur in organic compounds by heating them in a short combustion tube mixed with chromate of copper. The chromate is prepared by precipitating a solution of potassic bichromate (which must be quite free from sulphur) with cupric nitrate, and washing the precipitate twice. It is then dried at 100° C. The combustion must be proceeded with slowly, and the front part of the tube heated just high enough to prevent condensation of moisture. The contents of the tube, after cooling, are dissolved in chlorhydric acid, digested with alcohol, and, after complete reduction, filtered and precipitated with baric chloride. It is the principal advantage of the use of this copper salt over that of the mixture of sodic carbonate and potassic nitrate, that from the absence of any action on the combustion tube, no silicic acid becomes mixed with the products of the reaction.—*(Ann. Chem. Pharm.*, cxlv., 25).

Artificial Methylic Alcohol.—E. Linnemann.—Methylamine was prepared from cyanhydric acid, with slight modifications, according to Mendius's method, and converted into methylic alcohol by means of argentic nitrite in the manner described on a former occasion (*vide* Chemical News, No. 436, p. 181). The corrected boiling point of the pure alcohol at the normal barometrical pressure (·670 m.) is 67·1° C., sp. gr. at + 21° = ·8574. The iodide of the alcohol has the sp. gr. at 25° = 2·269, and boils under a pressure ·738m. at 42·5°. These observations prove the identity of the alcohol obtained from cyanhydric acid with the methylic alcohol from wood spirit.—*(Ann. Chem. Pharm.*, cxlv., 42).

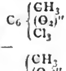
Conversion of Methylic into Ethylic Alcohol.—A. Siersch.—Acetonitrile, prepared by acting upon potassic methylsulphate with potassic cyanide, was converted into ethylamine, and from the nitrite of that base, alcohol was obtained. This alcohol was found to be a mixture of ethylic and methylic alcohol, in the approximate proportion of 4 to 1. The author explains the presence of the latter by the assumption that during the decomposition of the nitrite of ethylamine alcohol has been regenerated.—*(Ann. Chem. Pharm.*, cxlv., 46).

Toluquinone.—C. Graebe and E. Borgmann.—The authors have obtained from cressylic alcohol, by treatment with potassic chlorate, a mixture of chlorinated quinons of toluol, which they succeeded in separating into trichlortoluquinone—



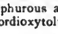
$$C_6\left\{\begin{matrix}CH_3\\(\Theta_2)''\\Cl_3\end{matrix}\right.$$

and dichlortoluquinone—



$$C_6\left\{\begin{matrix}CH_3\\(\Theta_2)''\\Cl_2\\H\end{matrix}\right.$$

Their physical properties resemble closely those of the chloroquinones. Sulphurous acid converts the trichloro-compound into trichlordioxytoluol—



$$C_6\left\{\begin{matrix}CH_3\\(\Theta H)_2\\Cl_3\end{matrix}\right.$$

—*(Zeitschr. Chem.*, N.F., iv., 118).

NOTICES OF BOOKS.

A Dictionary of Chemistry and the Allied Branches of other Sciences. Founded on that of the late Dr. Ure. By Henry Watts, B.A., F.R.S., F.C.S., Editor of "The Journal of the Chemical Society," assisted by Eminent Contributors. In Five Volumes. London: 1868. Longmans, Green, and Co.

The greatest work which England has ever produced on chemistry, one of the greatest indeed which she has produced upon any scientific subject, is finished at last, and we are able to congratulate Mr. Watts most sincerely upon its completion. The first number was issued more than five years ago, and though some slight delays have latterly occurred, the publication has been carried on with most commendable regularity. The general confidence in the learning and energy of the editor, which his previous labours had inspired, has been justified in the fullest manner, and every chemist will be proud to acknowledge the debt of gratitude which he owes to him. Very few, even among the few who were fitted for such a task, would have cared to undertake it, and no one who had undertaken it could possibly have executed it more ably or thoroughly.

The Dictionary is said to be "founded on that of the late Dr. Ure." The first edition of the latter work was published in 1820, and was professedly based on the previous dictionary of Nicholson, which first saw the light in 1795, so that the new comer can boast of a very respectable pedigree. It is not a little curious to compare the three works with one another, and to mark the gigantic growth which the science made between each. The task of the editor has grown in a like proportion, and it is appalling to contemplate what it is likely to be when some chemist of the future founds a new dictionary of chemistry on that of Mr. Watts.

There is, of course, very little to say about the arrangement of the book. The alphabetical order is strictly preserved, and the editor has, we think, wisely distributed the subject as much as possible under different headings. Thus we find in separate articles,—Nitrogen; Nitrogen, chloride of; Nitrogen, detection and estimation of, &c. Difficulties occur, of course, as they would in any system, but they are lessened as much as possible by cross-references, and by the care which has generally been taken to mention each substance in as many places as it has names. The few obscurities which occur are due to the accidental neglect of this practice, and even these generally disappear when the reader has become familiar with the method of the book. Sulphuretted hydrogen may be cited as an instance of such a difficulty. This compound is not included in the elaborate monograph on the sulphur-compounds, and it cannot be found as "sulphuretted hydrogen," "hydrosulphuric acid," or "sulphydric acid." A student unfamiliar with the system adopted might hunt for some time before he thought of looking for "Hydrogen, sulphide of," under which heading the substance is described.

The subjects treated of may be roughly divided into the following classes:—

I. Pure chemistry, which might be subdivided into theoretical, methodological, descriptive, and analytical.

II. Applied chemistry, including the applications of the science to animal and vegetable physiology, geology and mineralogy, metallurgy and technology.

III. Physics and physico-chemistry.

The range it will be seen is very extensive, and though the volumes contain more than 5,000 closely printed pages, it is marvellous that room has been found for so vast a number of facts and detailed descriptions as we find collected in them. Nothing but the most careful condensation and the most rigorous exclusion of all irrelevant matter, could have made it possible. The writers have obviously held it to be their first duty to present in each paper the utmost possible amount of fact, and to sacrifice almost every thing, except accuracy and clearness, in order to attain this end. This desire is most evident in Mr. Watts's articles, in which condensation is carried so far as sometimes to interfere slightly with the unity and intelligibility of the paper, and to render it somewhat unnecessarily dry. But the gain to the book, as a work of reference, which the system has produced, is so unmistakable that it would be ungracious to cavil at the disadvantages which are inseparable from it.

There is, of course, one broad and grave imperfection to be observed in the dictionary which no care or skill could have avoided; science will not stand still, even to oblige an editor, and while he is concentrating his energies on vol. ii., vol. i. *will* fall a little behind. This difficulty is the greatest in books which are brought out in parts, and attempts to obviate it by *addenda* tacked to the end of the volumes are seldom more than partially successful. In all such books the later volumes must have an advantage, and the reader must be content to suffer some loss if the initial of the word he wants stands high up in the alphabet. We remarked in noticing the first volume that "Weights atomic" would probably have been in some respects a different article from "Atomic Weights," and in looking over the last two numbers every chemist will rejoice that "Water Analysis" did not form a portion of the article on analysis. Professor Masson once remarked that the only way to turn out a perfect encyclopædia would be for the rest of Europe to unite, subjugate the German people, and then, having supplied them with unlimited beer and tobacco, were to keep their captives hard at work until the task was accomplished. Some such simple and convenient arrangement would no doubt yield us a synopsis of chemical science which should be complete up to a certain date, but, pending its adoption, it is open to us to hope that a few of its advantages may be secured to us in a cheaper and more orthodox fashion. In a word, may we not hope that Mr. Watts will publish a supplementary volume? To carry the great work on a little farther and make it represent chemistry accurately down to a certain definite point, say to the 30th June, 1868, would surely be no very immense labour for Mr. Watts's learning and industry, and it can scarcely be doubted that such an addition to the dictionary would turn out as remunerative as it certainly would be valuable. And we will not deny that an ulterior hope lurks behind this primary one. It is high time that we had an English "Jahresbericht," a quarterly or half-yearly report of the progress of Chemical Science, which should be as full and accurate as the great German work, and a little more punctual in its appearance. It is true that the experiment was tried twenty years ago and failed, but then, as the Master of the Mint observed at one of the meetings of the Cavendish Society, the number of chemical readers now is very different from what it was then. And as soon as England and America abandon their present miserable system of mutual pilfering and agree upon an international copyright act, a large additional market for such a work will be thrown open on the other side of the Atlantic. The completion of "Watts's Dictionary," by a supplementary volume and general index, would form a grand basis for the commencement of a journal of the kind, and successive editions of the dictionary might then present the scientific public periodically with a digest of the recent acquisitions which the science had gained. Mr. Watts's most valuable habit of quoting the original memoirs with chapter and verse upon every occasion, renders his book particularly suitable to be the starting point of such a series.

The following may be cited as good examples of the theoretical and methodological articles of the book:—'Acids,' 'Classification,' 'Formulæ, Rational,' 'Nomenclature,' 'Notation,' and 'Salt,' by Professor Foster; 'Atomic weights,' 'Equivalents,' and 'Metals, atomic weights and classification of,' by Professor Odling;

'Metals and metalloids,' by Dr. Paul; 'Organo metallic bodies,' by Professor Frankland; 'Isomerism' and 'Secondary alcohols,' by Professor Wanklyn, and 'Alcohols,' 'Aldehyds' (rather short and imperfect, with an obvious error as to oxide of ethylene, but then the word begins with A), 'Atomic volume,' 'Chemical affinity," 'Hydrocarbons' (likewise too short), 'Isomorphism,' 'Substitution,' and 'Types,' with many others, by Mr. Watts. It will be seen that a considerable proportion of this part of the work has fallen upon Professor Foster. The editor's choice has been a wise one, for the articles are written with singular clearness and simplicity, and with careful and thoughtful study. 'Nomenclature' is a good sample. It begins in the following words:—

"Chemical Nomenclature is the spoken language of chemistry, as the Symbolic Notation is the written language of the science. Being thus at once the product and the instrument of thought upon Chemical subjects, it has necessarily, at every period in the history of the science, reflected the general intellectual character of the time, as well as the stage of development which chemistry had reached."

Accordingly the modern system is introduced by a learned and highly interesting historical sketch, in which the successive changes which chemical names have undergone, from the Sol and Luna of the early writers down to the marvellously flexible system of the present day, are described so well as to make the story quite amusing. We commend the introduction of these historical notices, and are glad to find that Professor Foster has adopted the practice in several articles, and that several other writers, among whom we may mention Dr. Paul, whose article—"Gas"—is entirely occupied with the history of the subject, have done the same.

We should have felt it necessary to allude at some length to Dr. Odling's contributions to the work, if we had not done so on a previous occasion (vol. xiii., p.p. 31-57). Of course they are very good, and the exposition and frank adoption of the Cannizzarian system in the last of them are admirable in every sense. Professor Wanklyn does not appear to have contributed very much, but what he has done is good and well written. Probably if he had to write the article on "Isomerism" now he would find more to say, but, having wisely abstained from mere speculation, he would not find much that required alteration. The article was published in 1864, while that on "Secondary Alcohols' did not appear till 1866. Curiously enough these same secondary alcohols, the study of which had hardly commenced when the former article was written, had in the meantime thrown a most important light on the nature of isomerism. In the latter article the author has made the mistake of not giving sufficient references. He should moreover have explained the nomenclature which Kolbe and Butlerow employ. He does not even mention it, and only alludes to trimethylcarbinol under the much less significant name of "Abnormal butylic alcohol." And lastly, for the sake of those who are not familiar with the subject, he should have given the names, and not merely the formulæ of the compounds concerned in the genesis of the alcohols, especially as the formulæ are of a different kind from those usually employed in the book. Professor Frankland's article on the "Organo-metallic bodies," calls for no remark, it being simply a condensed and corrected reproduction of his well-known lecture delivered to the Chemical Society, June 7, 1863,—a lecture which was published in the Society's Journal, and which is familiar to every chemist in England.

Turning now to the descriptive articles, which constitute the great bulk of the book, we find very much to admire and very little to find fault with—so little, indeed, that we do not care to find fault at all. It is indeed unnecessary to say much about them, for nearly all our readers know the book, and have been using it constantly for years, and those who have not taken in the monthly parts will soon find themselves compelled to buy the complete work. Nearly the whole of this portion of the work is from the pen of Mr. Watts; but he has received valuable assistance in a few important subjects, of which the following will serve as samples:—Amyl and its associates, by Professor Guthrie; "Atmosphere," by Professor Roscoe; the Ammonia and Benzoic series, by the late Mr. Conington; Bismuth, and the Butylic series, by Dr. Atkinson; "the Hexyl group," by Professor Wanklyn; "Naphthaline," by Mr. Greville Williams; and the lactic series, by Professor Foster. The late Mr. Long was also a useful contributor, and in illustration of his style we may refer to the articles "Blood," "Casein," "Fibrin," "Milk," "Gelatin," and "Garnet."

The following are some of the chief articles on analytical chemistry. They are all excellent, and so nearly equal, that it would be unfair to single out any one of them for praise:—"Analysis, inorganic," by Mr. Conington, who wiesly left quantitative analysis to separate articles; "Analysis, (organic)," a full and lucid treatise, by Mr. Watts; "Analysis (volumetric) of liquids and solids," (Mr. Dittmar); "Analysis (volumetric) of gases," (Dr. Russell); "Spectral analysis," (Professor Roscoe). Our limits make it impossible for us to do more than give the titles of these papers.

Another large portion of the book is occupied with the various branches of Applied Chemistry. In spite of the immense interest and importance of these subjects, we find with regret that we can do little more than give the names of some of the most important articles. The reviewer's taste, in dealing with a book of this magnitude, is indeed a somewhat unsatisfactory one. The space at his command is hopelessly inadequate for anything like a complete examination of the work, and, with all his efforts to distribute his notice fairly, he is sure to be haunted by an uneasy feeling that he has given too much to some and too little to others.

Some of the best articles in Physiological Chemistry are by Dr. Michael Foster, whose name does not appear until the middle of the third volume. "Nutrition," "Respiration," "Muscular tissue," "Nervous tissue," and "Pancreatic juice," are good examples. It is somewhat unfortunate for physiologists that the masterly essay upon nutrition was written just before the publication of works so important as Ranke's "Essay on Tetanus," Fick and Wislicenus's memoir on the "Origin of Muscular Power," and Frankland's determination of the Calorific Value of Food and Urea." But the author has reasoned too accurately to fall into the error of Liebig and others, and his paper is therefore even now rather incomplete than incorrect. Akin to these subjects are the various articles upon vegetable physiology, agriculture, &c., which are scattered through the book:—"Nutrition of Plants," by Dr. M. Foster; a very good one on "Manure," by Dr. Paul; and another on "Soils," by Mr. Watts, are among the most important.

Of the Metallurgical articles which we meet with, the following are the chief:—"Copper" (very clear and complete) and "Zinc," by Mr. Watts; "Iron" and "Silver," by Dr. Paul; "Lead," by the late Dr. Richardson (nearly 70 pages long: excellent, but too technical, we think, for a book on chemistry); "Tin," by Mr. Field; and "Gold Assay," by Mr. Jevons. Technology is but slightly represented in the book, the editor having wisely left it to the elaborate special treatises upon the subject which now exist. The recent new edition of "Ure's Dictionary of Arts," and the valuable work, founded on "Knapp's Technology," of Richardson and Watts, leave little to desire in this respect. Many of the articles in the work before us are, however, concerned more with technology than pure chemistry; and Mr. Watts's papers on "Soap," "Dyeing," "Alcoholometry," &c.; Dr. Richardson's "Potassium-salts, manufacture of"; Mr. A. W. Wills's "Coal" and "Coal-gas"; and Dr. Paul's "Fuel," "Paraffin," "Peat," and "Petroleum," will be sufficient to show the manufacturer how large an interest he has in the book.

It only remains to us now to notice, in few words, the very important and copious articles which have been allotted to Physics. The following list comprises the most important of them, arranged according to their authorship :—"Crystallography," "Diffusion" (distributed through various articles), "Electricity," "Light," and "Magnetism," by Mr. Watts; "Heat," and "Radiation and Conduction of Heat," by Professor Foster; "Gas, absorption of," and "Light, chemical action of," by Professor Roscoe; "Specific Gravity," by Mr. Greville Williams; and "Balance," "Clouds," "Barometer," and "Thermometer," by Mr. Jevons. Mr. Watts's contributions in this department are among the best he has written, and are decidedly superior to his articles on theoretical chemistry. He seldom expresses an opinion of his own, but contents himself with collecting and arranging with immense skill all that is trustworthy upon the subject he is treating. Now and then a few words of acute commentary occur, when they are absolutely necessary, but he evidently tries to avoid the necessity. This is just the way to give the greatest value to a book of this kind. Original essays are of course of primary importance and utility, but a dictionary is not the place for them. The reader of a dictionary generally wants to find, not what some single writer has said upon a subject, but the aggregate of facts, theories, and opinions which have accumulated up to a certain date, and he is sure to bless the editor who has been self-denying enough to sink his own opinions, and to devote his whole labour to the elucidation of the labours of others. It is, perhaps, not too much to say that no man in England is so fit for the labour of a scientific editor as he to whom we owe our dictionary. Wishing to avoid hyperbolical praise, it is indeed difficult to speak calmly of the service which Mr. Watts has rendered to science. Some four-fifths of the entire work are from his pen, and he is therefore entitled to be considered as the author, and not the mere editor of it. His learning is universal, and not only carries him through every corner and byeway of pure chemistry but also makes him at home in every one of its branches. When we consider that he has contributed important articles in each section of chemical science, that he has written with nearly equal learning upon digestion and magnetism, atomic volumes and soap, and that he has besides had the labour of compiling nearly all the smaller articles, and of selecting and arranging the whole book, we feel justified in speaking with a certain enthusiasm of the chemist who has so well carried out so great a work.

We have purposely said very little of the few faults and omissions which we have found in the Dictionary. Of course there are some, but they are few and in most cases trifling; and as the utmost that we could attempt would be to pick out an instance here and there, as, moreover, a new edition cannot reasonably be looked for for some time, we see no good that would be served by the scrutiny. And it is far pleasanter, in praising a good book, to praise it cordially, without hypercriticism or carping reservations. Every chemist who understands the English language will, we feel quite certain, join heartily in our praise.

Another Explosion of Nitroglycerine.—We have received accounts of a disastrous explosion caused by this dangerous compound at Quenast, in Belgium. About 1,800 kilos were being conveyed in a waggon to the quarries belonging to M. Zaman, where it was to be used for blasting purposes, but while it was being removed from the waggon a tremendous explosion occurred. Ten persons were killed instantaneously. A large store close by was quite destroyed, and the houses, trees, and fields within an area of 500 yards were devastated. Fortunately the quarrymen were not at work at the time, or the explosion would have been a still greater calamity, there being about 700 men employed in the works.

CORRESPONDENCE.

DEATH FROM CARBOLIC ACID.

To the Editor of the Chemical News.

Sir,—Will you kindly allow us sufficient space to say that the jury's verdict on the cause of Mr. Berger's death is evidently in error where it states that the *inhalation* of carbolic acid produced the lamentable result.

Our workmen frequently *inhale* carbolic acid in very large quantities during the process of its manufacture, and we have not known a single instance of ill-effect therefrom; and we can also state that it has been most extensively used in *proper inhalers* for several years in the cure of consumption, throat and chest diseases.

To us it is very evident that Mr. Berger died from the effects of accidentally *drinking* carbolic acid, and had any one been at hand to administer promptly a mixture of sweet oil and castor oil, his life might possibly have been saved.—We are, &c.,

F. C. Calvert & Co.

Manchester.

HIGH CHEMICAL FORMULÆ.

To the Editor of the Chemical News.

Sir,—I have to correct an error committed by me in the course of the discussion at the last meeting of the Chemical Society.

Sir B. Brodie describes in his papers the ethylic ether of one of the wax-acids, and not the acetate of a wax-alcohol. By a strange, but intelligible oversight, I had confounded the one with the other. This mistake, which is here rectified, has, as will be obvious, no influence on the main questions which were before the Society.

When I have leisure, I may possibly set to work to prepare acetate of melissyl by the process sketched out by me.—I am, &c.,

J. Alfred Wanklyn.

London Institution,
June 29, 1868.

MISCELLANEOUS.

Chemical Society at Newcastle—We are glad to hear that, at a meeting held on Monday evening last, at the Literary and Philosophical Institution, under the presidency of Sir William Armstrong, K.C.B., it was decided to form a "Newcastle Chemical Society." Meetings are to be held monthly from October to March. Messrs. E. J. J. Browell, R. Calvert Clapham, H. B. Brady, A. Friere Marreco, J. W. Swan, J. Pattinson, B. S. Proctor, W. H. Richardson, and Dr. Lunge, were constituted a committee to make the necessary arrangements.

Death of Professor Matteucci.—The Italian papers record the death of Professor Matteucci on Friday morning last, at Florence, after a short illness. The deceased was an Italian senator and Minister of Public Instruction, in which capacity he was very active in promoting the extension of education. But he was better known as a man of science than as a politician or a minister. He obtained, in 1844, the prizes of the French Academy of Sciences and the Copley Medal of the Royal Society for his investigations in electro-physiology. His "Lectures on Physics" passed through four editions. He published also "A Manual of Telegraphy," "A Treatise on Electro-physiological Phenomena," "Elements of Electricity as applied to the Arts," and "Lectures on the Physico-chemical Phenomena of Living Bodies," which has been translated into English and French.

Utilisation of Sewage.—Some experiments just completed at Tottenham seem likely to throw some light on this question. A new mixture of several chemical ingredients introduced by Mr. Sillar has been tried on a large scale, and with considerable success, the impurities being precipitated more rapidly than by either the alum or the lime process. The proportion of the organic matter carried down is very large, and 85 per cent of the ammonia is fixed. At Tottenham a 5000 gallon tank was filled and precipitated eight times in succession, the average time occupied being but little more than 20 minutes. The analysis of the supernatant water shows that it contains but 2 grains per gallon more organic water than the Tottenham water supply, and of its saline constituents by far the larger proportion is common salt—the refuse of a manufactory. The mud has since been dried, and weighs about 8 cwt. It contains enough ammonia to make it in all probability a marketable article; and its value is expected to pay all expenses. 40,000 gallons were afterwards purified in a larger tank, the time occupied, including filling, was less than an hour; the water was almost free from either taste or smell. Some larger experiments are about to be tried under the direction of Mr. Wigner in another town.

ABSTRACT OF ANALYSIS OF SEWAGE, &C.

Mr. Sillar's Process.

	Average Sewage.	Average Water from Sewage.	Tottenham Water.
Total solid matter, per gallon	203·89	81·96	48·70
Organic matter	109·20	14·62	11·31
Ammonia	3·97	·584	—
Phosphoric acid	7·23	—	—
Common salt	57·10	57·51	9·21
Silica, alumina, and various salts	30·36	9·82	28·18

MANURE OR SEWAGE RESIDUE.

Water		4·45
Organic matter containing ammonia	2·37	20·05
Phosphoric acid		5·33
Sulph. Lime		1·67
Silica, alumina, and various salts		68·50
		100·00

Behaviour of Albumen and Fibrin in Air free from Dust.—Dr. Gunning relates a remarkable instance of the different behaviour of these two substances; in the year 1862 he repeated some of the well known experiments of Pasteur concerning the behaviour of some organic substances prone to rapid decomposition, while kept in air free from dust, and so that dust can have no access to the substances under trial. In the above-named year Dr. G. took fibrin obtained from blood by agitating it with small twigs and washing it with water; it was then placed in bottles (ordinary large water bottles of from 2 to 3 litres cubic capacity) covered with water, while, afterwards, in the neck of the bottle a piece of cotton wool was placed; a rapid current of steam was now passed into the bottle through a glass tube which reached to the bottom of the bottle, and continued for about 20 minutes; the tube was carefully raised while steam was yet passing and without disturbing the tuft of cotton, immediately after the neck and mouth of the bottle was covered over with a piece of filtering paper, and the bottle left to itself. At the end of 1867, the water standing over the fibrin had not even become turbid, and the fibrin itself was unaltered. A similar experiment, made with albumen (obtained from eggs by diluting the white of eggs with water, filtration, coagulation by heat, and addition of a few drops of acetic acid, and careful washing of the coagulum previous to being placed in a bottle, in a similar manner as just described for fibrin), proves also, at the end of the year 1867, that under the same circumstances albumen always undergoes a change, but one essentially different from that which it undergoes when exposed to ordinary air, No infusoria, or mouldiness is seen; the albumen becomes slowly dissolved and, provided the bottle is not exposed to light, the resulting liquid is hardly more than just yellowish coloured, but milky; no sulphuretted hydrogen is given off, but the sulphur originally contained in the albumen is found as sulphuric acid. The liquid contains, moreover, ammonia, butyric and valerianic acids; on evaporation it yields a substance which represents, in bulk and weight, only a small portion of the albumen originally submitted to the experiment.

NOTES AND QUERIES.

Analysis of Iron Ores.—I have hit upon a "dodge" lately which saves a great deal of time in the analysis of some kinds of ferruginous minerals. On attempting to dissolve in HCl, a certain residue remains (with hematite ore, for instance); and it is rather a long process to have recourse to fusion with sodic carbonate to separate the silica and iron. I tried fusion with bisulphate of potassa at a dull red heat, which converts the iron into a sulphate, leaving the silica beautifully white. The time is, for 1 grm. of mineral, about 10 to 15 minutes. Should sulphur and phosphorus be required, they may be obtained by drenching a sample with fuming nitric acid, and manipulating in the ordinary manner. The residue may then be treated with bisulphate, to separate the remainder of the iron from the silica.—W. M. B.

Printing Ink.—Is there any method of extracting printing ink from paper, and if more than one, which is best?—Paper-maker.

Size for Velvet.—I want a very adhesive size by which I can attach either gold or silver leaf on velvet pile. The size must not injure the metals attached, nor the velvet, and to be worked cold when applied.—D. C.

Colour of Oil.—It is well known that few liquid oils retain their normal colour for any length of time, especially if exposed to the light, and in consequence of this, frequent disputes arise in commerce between buyers and sellers on oil contracts. It is very desirable for this and other reasons, to be able to prepare a coloured chemical solution, which might by dilution, or otherwise, be made to represent say—refined petroleum, heavy and light; refined coal oil, ditto; refined rape oil, refined cotton seed oil, &c.; and at the same time remain permanent whether kept in the light or dark. Perhaps some reader of the Chemical News could assist us in this matter?—Oil Refiner.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Comptes Rendus.

March 16, 1868.

Payen, "A Method of Extracting Cellulose in an unaltered condition from the Epidermis of Plants." A. Strecker, "On a new Mode of Formation of Organic Sulpho-acids. On the Transformation of Uric Acid into Glycocol." C. Friedel and A. Ladenburg, "On an Oxychloride of Silicium." A. Bechamp, "On the Reduction of Nitrates and Sulphates in certain Fermentations." Maumene, "Note on the Composition of the Potash obtained from Suint, *àpropos* of Chevreul's paper 'On Manures, &c.'"

March 23, 1868.

Chevreul, "On the Presence of Copper in Organised Bodies." Berthelot, "On the Pyrogenous Hydrocarbons." A. Descamps, "On the Double Cyanides analogous to the Ferrocyanides and Ferricyanides." L. Sauvage, "Note *àpropos* of Houzeau's Papers respecting the Decomposition of Iodide of Potassium by Sulphuric Acid."

Annalen der Chemie und Pharmacie.

March, 1868.

A. Butlerow and M. Ossokin, "On the Synthesis of Alcohols, and on the Chemical Constitution of Ethylene." A. Butlerow, "On some Hydrocarbons of the Series C_nH_{2n}." A. Popoff, "On the Isomerism of the Ketones. On Ethyldimethylcarbinol." R. Otto, "On some Derivatives of Benzol and Toluol." H. Limpricht and H. Schwanert, "On some Compounds of the Toluol Series." R. Otto, "Note on the Action of Nascent Hydrogen on Benzoglycolic Acid." A. W. Hofmann, "On the Preparation of Methylic Aldehyde." E. Erlenmeyer, "On the Dicarbonic Acids obtained from Chloride of Ethylidene." A. Froehde, "Note on a new Reaction of Albuminoid Substances."

Annales de Chimie et de Physique.

February, 1868.

A. Houzeau, "On the Estimation of Minute Quantities of Peroxide of Hydrogen." Berthelot, "On some Chemical Apparatus:—(1) An Improved Gas Lamp; (2) Pipette for Transferring Gases; (3) An

Apparatus for Decomposing Formic Acid; (4) An Apparatus for the Synthesis of Acetylene. A new Thermometer for indicating Temperatures above the Boiling Point of Mercury." **Thiercelin**, "On the Nitrate of Soda Deposits of the Province of Tarapaca, Peru."

Comptes Rendus.

March 30, 1868.

P. **Schutzenberger**, "On a New Platinum Compound." **Terreil**, "On the Analysis of Minerals: Action of Ammoniacal Salts on Native Carbonates." H. **Debray**, "Researches on the Combinations of Molybdic Acid with Phosphoric Acid." A. **Houzeau**, "Answer to L. Sauvages's Remarks on the Author's Papers respecting the Decomposition of Iodide of Potassium by Sulphuric Acid."

Poggendorff's *Annalen der Physik.*

No. 2. 1868.

P. **Groth**, "Contributions to the Knowledge of the Perchlorates and Permanganates." A. **Foster**, "An Account of some Methods of Preparing Phosphorescent Compounds." W. **Muller**, "On the Method of Preparing and Properties of Soft Yellow Sulphur."

Bulletin de la Société Chimique de Paris.

January, 1868.

A **Gautier**, "On Acetonitrile and Propionitrile." **Berthelot**, "On Oxysulphide of Carbon."—A general Method of Reducing and Saturating Organic Compounds with Hydrogen." **Thiercelin**, "On the Nitrate of Soda Deposits of Peru." E. **Bourgoin**, "A general Theory of the Electrolysis of Organic Acids and their Salts.—On the Electrolysis of Formic Acid." P. **Berard**, "Note on Canauba Wax." **Scheurer-Kestner** and **Rosenstiehl**, "Note on the Composition of the Residues left after roasting Iron Pyrites."

February, 1868.

Thiercelin, "On the Nitrate of Soda Deposits of Peru." **Lauth**, "On the same Subject." **Cloez**, "On the same Subject." E. **Bourgoin**, "Researches on the Electrolysis of Organic Acids and their Salts." **Jungfleisch**, "Researches on a Second Series of Chlorinated Derivatives of Benzine. G. **Tissandier**, "Analysis of the Water of the Mineral Spring of Villa Salice, near Voghera, Piedmont," **Debray**, "Researches on Dissociation." E. **Bourgoin**, "On the Electrolysis of Camphoric Acid." **Berthelot**, "A General Method for Reducing and Saturating Organic Compounds with Hydrogen.—On the Formation of Acetylene in incomplete Combustions by Means of the Voltaic Battery.—On some Thermo-chemical Phenomena which accompany the Re-action of Hydriodic Acid on Organic Matter.—On some General Conditions which affect Chemical Reactions."

Journal fur Praktische Chemie.

March, 1868.

Ritthausen, "On Vegetable Casien or Legumin." R. **Fresenius**, "On the Composition and Properties of the *Rothholz* (partially Carbonised Wood), manufactured by the Chemical Products Company at Mayence." G. **Stadeler**, "On the Constitution of Sulphophenylic Acid.—Note on Anisic Aldehyde.—On the Preparation of Permanganate of Potash." A. **Eulenburg**, "On the Formation of Sugar in the Liver." K. **Von Hauer**, "On the Relative Solubility of Isomorphous Salts and Mixtures of the same. K. **Haushofer**, "On the Decomposition of Granite by Water." R. **Hermann**, "On the Composition of the Columbites, and on the Preparation of the Acids of Tantalum, Niobium, and Ilmenium from that Mineral." F. **Ullik**, "On some compounds of Tungstic Acid." F. **Von Kobell**, "On Typical and Empirical Formulæ of Mineralogy." F. **Reindel**, "On Hatchett's Brown, and on a Triferrocyanide of Sodium and Potassium." W. **Stein**, "On the Manufacture of Ultramarine Paper, and on the Action of Neutral Alum on Ultramarine and Hyposulphite of Soda." E. **Mulder**, "On Sulphocarbamic Acid and some of its Salts."

PATENTS.

Communicated by Mr. **Vaughan**, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1854. R. Elsdon, Brockham, Surrey, and A. Stein, Ryder Street, Middlesex, "Improvements in the manufacture of glass, or similar vitreous substances, and in the application of such substances in the construction of buildings."—Petition recorded June 5, 1868.

1860 J. Dewar, M.D., Kirkcaldy, Fife, N.B., "Improvements in preserving and arresting decay in certain vegetable substances for the purposes of food and manure."

1868. J. Young, Kelly, Renfrewshire, N.B., "Improvements in treating hydrocarbons."—June 6, 1868.

1885. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of oxide of iron, with a view to its use in blast furnaces."—A communication from A. Deligny, Paris.—June 8, 1868.

1888. W. Ferrie, Monkland Iron and Steel Works, Lanark, N.B., "Improvements in and connected with smelting or blast furnaces."

1890. W. Hamer, Bowdon, and J. Davies, Runcorn, Cheshire, "Improvements in the furnaces of salt pans."

1892. C. W. Siemens, Great George Street, Westminster, Middlesex, "Improvements in the manufacture of cast steel, and in furnaces and apparatus employed for that purpose."—June 10, 1868.

1909. E. R. Southby, Lanark, N.B., "Improvements in utilising oleaginous acid waste."

1912. W. E. Newton, Chancery Lane, "An improved adhesive cement, applicable to uniting china, leather, and other hard and soft substances."—A communication from C. D. Peasley, Biddeford, Maine, U.S.A.—June 11, 1868.

1920. A. L. Henry, Boston, Massachussets, United States of America, "Improvements in treating quartz and silicious substances to obtain hydrate of silica, and in applying the same to various useful purposes."

1922. J. Gray and R. Weir, Glasgow, N.B., "Improvements in treating ores and in refining crude metals, in order to obtain steel, copper, tin, and lead, and in apparatus therefor."—June 12, 1868

NOTICES TO PROCEED.

496. H. A. Bonneville, Rue du Mont Thabor, Paris, "Certain improvements in compound of aniline colours."—A communication from E. Zinssmann, New York, U.S.A.—Petition recorded February 14, 1868.

686. C. Sanderson, Worksop, Nottinghamshire, "Improvements in the manufacture of iron and steel."—February 28, 1868.

1485. A. C. Henderson, Charing Cross, Middlesex, "Improvements in the mode of manufacturing albumen, and in the apparatus connected therewith."—A communication from L. Lévy, Paris.—May 6, 1868.

TO CORRESPONDENTS.

E. Roman.—The atomic weights of cobalt and nickel are considered to be identical. If you can *prove* them to be different it will go far to corroborate the theory you have started, but without some experimental evidence we must decline to fill our pages in the way you propose.

A Soap Maker, who forwards a letter asking for detailed information respecting various kinds of soap, is informed that such queries are considered not to fall within the province of our Notes and Queries. An advertisement will doubtless procure the desired information.

Druggist.—See answer to "Soap Maker."

W. B.—1. Dissolve the white lead in acetic acid: an insoluble residue will denote impurity. 2. "Fresenius's Quantitative Analysis," published by Churchill.

Xylol.—The new green aniline dye.

J. Brode & Co.—We will endeavour to ascertain the address required.

C. G. G.—Apply to Asher's, Bedford Street, Covent Garden.

D. Howell.—"Roscoe's Chemistry," published by Macmillan.

Communications have been received from H. Hughes; Dr. Calvert, F.R.S.; Dr. E. Röhrig; C. Bailey; D. Howell; C. Greville Williams, F.R.S. (with enclosure); Dr. Attfield; J. Wylde; Messrs. Townsend and Adams (with enclosure); Alexis Lomonosoff; Professor H. Morton (with enclosure); W. M. Bowron (with enclosure); J. Geddes; J. Adolphus; H. Verquin; S. Sebold; W. May (with enclosure); D. Forbes, F.R.S. (with enclosure); A. Vernon Harcourt, F.R.S. (with enclosure); M. Holdsworth (with enclosure); Professor Heaton (with enclosure); D. Clifton; J. Hunter, M.A. (with enclosure); W. White (with enclosure); Beer and Co. (with enclosure); J. H. Freeman (with enclosure); F. A. Genth (with enclosure); Edwards and Bult; J. H. Cox (with enclosure); Rev. A. Rigg (with enclosure); J. Mercer (with enclosure); R. Rumney (with enclosure); Burnard, Lack, & Co. (with enclosure); W. Briggs (with enclosure); Dr. J. Stenhouse, F.R.S. (with enclosure); Prof. Pavesi (with enclosure); Bailey and Son; E. Smith; W. W. Biggs; Dr. J. Blyth; P. Holland; and T. Blair.

BOOKS RECEIVED.

Observations upon a New and Simple Process for the Preservation of Meat and other varieties of Animal Food. London: Simpkin and Co.

What shall we Drink? By J. L. Denman. London: Longmans and Co.

The Principles and Practice of Photography. By Jabez Hughes.

Braithwaite's Retrospect of Medicine. Vol 57, January to June, 1868. London: Simpkin and Co.

Photographic Manipulation. By Lake Price. Second edition. London: Churchill.

Progetto di Classificazione Tecnologica per una mostra di Prodotti naturali e manifatti. Da G. Arnaudon, Professore nel R. Instituto Industriale di Torino.

DR. REIMANN'S HANDBOOK OF ANILINE.
On Wednesday next, in 8vo. with 5 Woodcuts,

On Aniline and its Derivatives; a Treatise on the Manufacture of Aniline and Aniline Colours. By M. Reimann, Ph.D., L.A.M. To which is appended the Report on the Colouring Matters derived from Coal Tar shown at the French Exhibition of 1867, by Dr. Hofmann, and Messrs. De Laire and Girard. Revised and edited by William Crookes, F.R.S., &c.
London: Longmans, Green, and Co., Paternoster Row.

THE CHEMICAL NEWS.

Vol. XVIII. No. 449.

ON A NEW AMMONIATED CHLORIDE OF ZINC.

By EDWARD DIVERS, M.D., F.C.S.

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In an investigation (still in progress) of what appears to be a new class of zinc compounds, I found it desirable to make myself familiar with the ammoniated chlorides of zinc. Three of these have been described by Sir Robert Kane, namely, a monammoniated, diammoniated, and a tetrammoniated zinc chloride, zinc being treated as diatomic. I have obtained another, a pentammoniated chloride. To obtain it, solid zinc chloride is dissolved in the strong solution of ammonia of commerce, and as the solution of the first portions of chloride is attended with a marked rise of temperature, it is advisable to add the salt gradually, to close the vessel tightly to prevent expulsion of the ammonia, and to cool the vessel by a stream of cold water. When the solution of the zinc chloride becomes exceedingly slow, ammonia gas is passed into the liquid. If this is kept cool a crystalline precipitate soon forms; if, on the contrary, the liquid is not kept cool by the application of external cold, the liquid usually remains clear for some time. When the liquid in the cold state contains a moderate amount of deposit, the passage of ammonia into it must be stopped; then on closing the vessel containing it, and heating gently and shaking, the crystalline deposit may be redissolved. On cooling, the solution gradually yields the new chloride in large crystals of remarkable appearance. They are regular octohedra, with perfect angles and edges, but with deficient faces; that is to say, the faces are hollowed out in a series of steps from the edges to the centre of the face, so as to exhibit a structure similar to that seen in the hollow pyramidal crystallisations of sodic chloride. The mode in which such crystallisations of sodic chloride are produced is well known to be the formation of a small cube of the salt at the surface of the brine, to which it adheres by one of its faces, causing a depression in the fluid surface because of its density, and then the gradual addition to the upper external edges of the crystallisation of successive square courses of the sodic chloride. The formation of the hollow faces of the octohedra of the new ammoniated chloride of zinc is apparently partly similar to this—comparatively large crystals sometimes hanging from the surface of the mother liquor by a hollow face. But then all the faces of these octohedra are thus hollowed out so that their formation can have no necessary connection with crystallisation at the surface of the fluid; and to make the crystals of sodic chloride similar in their hollowed form to these octohedra, the cubical piece at the apex of the pyramid would have to be the centre and common apex of six such pyramids united in the form of a cubical flock with hollowed faces.

The crystals of this ammoniated zinc chloride give rise by their shape to a lively display of the prismatic colours while they remain immersed in their mother liquor, and are further distinguished from most crystalline bodies by being almost non-adherent to the vessel in which they form, and to each other, rolling about as the vessel is inclined. I have mentioned that the crystals are large. I may add in illustration that the largest of those formed in a night in about 50 cubic centimetres of liquor, and perfect of its kind, measured 8 m.m. in the edge. Exposed to the air they evolve ammonia, lose their lustre and transparency, and become eroded, thus indicating, perhaps, a composite structure. The eroding agent is undoubtedly the mother liquor which adheres to them when they are taken out of it, for this, by losing some of its ammonia, at once becomes a powerful solvent of them, as is shown in another way as follows:—If to the ammoniacal liquid filled with these crystals some solid zinc chloride be added, both it and the crystals dissolve, even if these are in such quantity as to make the whole semi-solid, the zinc chloride added combining with some of the ammonia of the ammoniated zinc chloride. The crystals attract moisture from the atmosphere as well as evolve ammonia,—at first losing weight and then increasing till they exceed their first weight, and at the same time partially liquefying. Whether the undecomposed salt is deliquescent it seems hardly possible to determine. They dissolve very rapidly in water, forming a clear solution till largely diluted. The results obtained by the analysis of this chloride are quite sufficient to determine its composition, but it was found to be very difficult to prepare it for examination because of its instability. The crystals were removed from their mother liquor, and, without washing, dried as rapidly as possible between folds of bibulous paper. One sample gave the following.—·269 gramme distilled with potash gave a distillate which showed by its neutralising power the presence of ·09435 gramme ammonia. ·2372 gramme dissolved in nitric acid, and neutralised, indicated, with a volumetric solution of silver, the presence of ·07318 gramme chlorine. Another sample dried with great rapidity, and imperfectly, gave the following results: ·7769 gramme gave by the volumetric method ·27557 gramme ammonia. ·22215 gramme indicated by the volumetric solution of silver the presence of ·06534 gramme of chlorine. The substance is therefore the pentammoniated zinc chlorine $ZnCl_2 5(NH_3)H_2O$.

	First Sample.		Second Sample.		
	I.	II.	III.	IV.	Calculated
Ammonia	35·07		35·47		35·57
Chlorine		30·85		29·41	29·68

I believe that I have also obtained a hexammoniated zinc chloride; but the difficulty of preparing it for analysis prevents me from being able to speak positively at present.

ON THE RATE AT WHICH CHEMICAL ACTIONS TAKE PLACE.

By A. VERNON HARCOURT, Esq., M.A.,

Secretary of the Chemical Society.

The science of Chemistry may be defined as the science which investigates the relations of the different kinds of matter one to another. The conception of different kinds of matter—each of which has its particular character, its own colour and crystalline form, its own hardness and brittleness, or the reverse, its own conducting powers, its own specific heat and specific gravity, and many other peculiarities of its own, and each of which is homogeneous, the smallest particle having all these properties equally with the largest mass—is the fundamental conception of chemistry.

And the whole world to a chemist is only a mixture of such different kinds of matter, whose mode of aggregation has been and is being determined by physical and vital forces which are foreign to his science, but whose resemblances and differences, and whose changes under changed conditions, or by contact one with another, form the subject of his study.

In the study of any chemical change there are two things to be discovered: first, the *result* of the change—what kinds of matter have ceased to exist and what have come into existence; and, secondly, the *course* of the change; as to which such inquiries as the following present themselves—at what rate does the change occur, and under what conditions? Is it simple, or does it consist of several changes? Are these dependent or independent, successive or simultaneous?—with many others of a more hypothetical kind as to the molecular nature of the change.

A familiar example of this two-fold nature of chemical inquiry may be drawn from the case of a fire, a chemical change which has been more watched than any other. We know all that is to be known as to the result of the change, when we have discovered that the coals are a mixture of various hydrocarbons with a small quantity of metallic salts, that the air is a mixture of oxygen and nitrogen, and that when the fire has burnt out, there exists, instead of so much coal and so much air, a quantity of carbonic acid and water, the salts, which form the ash, and the nitrogen remaining mainly as they were. But there is still much besides this to be found out as to the burning of the fire. How, for example, is the rate at which it burns affected by the draught, or by the density of the air, or by the breaking up of the fuel, or by access of the sun's rays? What are the substances formed from the heated coal which actually burn? Does the reduction of the products of combustion by carbon play an important part in the phenomenon? Such questions as these relate to the course of the chemical change.

The two lines of inquiry thus indicated have been pursued with very unequal vigour. The study of the results of chemical action has engrossed the attention of chemists almost to the exclusion of the study of their course. And, indeed, so great is the number of different kinds of matter, all capable of undergoing a multitude of changes by the action of heat or electricity, or, by contact with others, giving rise thus to new kinds of matter capable of similar changes, that this part of the science appears absolutely boundless. The direction which chemistry has taken in consequence of this superabundance of materials may, perhaps, be contrasted with that taken by physical science. If the number of distinct physical forces met with in nature, such as gravity, magnetism, electricity, heat, light, &c., instead of being quite a small number, had been a large number, and these forces had proved to be convertible not only one into another, but into an infinite variety of other distinct forces, physical experimentalists might have occupied themselves wholly with establishing the transmutations of one kind of force into another and creating new modes of force, instead of studying minutely, as they have done, the conditions under which the existing forces are produced, and the laws which govern their distribution and transformation.

It is, however, not only the vastness of the chemical field, and the particular satisfaction which so solid a result as the creation of a new kind of matter brings to the mind of the investigator, which has led to the neglect of the study of the course of chemical changes. This study is beset with peculiar difficulties, and indeed, out of the vast number of chemical changes whose results are known, there are but very few whose course can readily be observed. The principal reason of this is the velocity with which such changes take place; and this velocity is apt to be the greatest in the case of the simple chemical actions which are most suitable for investigation. Either, then, we must contrive some mode of estimating a very great velocity, as has been done for the measurement of the rate at which light and electricity travel, or we must select a change—and this the variety of chemistry makes possible—which proceeds at a rate convenient for observation.

Examples of the different velocity of chemical changes are furnished by the precipitation of a barium and of a calcium salt from their solutions upon the addition of a sulphate. With the former, the change is apparently instantaneous. The result is known, but the course cannot be observed. With the latter the change is gradual, and it would be possible to determine its rate at different temperatures and with different quantities of the two salts in solution.

The decomposition of a hyposulphite in an acid solution is another example of a gradual, observable change.

We may compare, also, the reduction of a chromate by a sulphite and by an oxalate. The former occupies no appreciable time; the actual time is, doubtless, greater in a more dilute solution and at a lower temperature, but we cannot discern any difference. But with an oxalate for reducing agent, though the final result of the change is the same, the action takes a long time to accomplish itself, and it would be quite practicable to observe in what way different circumstances affect its rate.

But in order to discover the laws which govern the rate of any chemical change, some exact mode of measuring the rate is necessary. It remains to show how this may be accomplished in certain cases.

A solution of ammonium nitrite, heated to a temperature of about 80° C. in a flask provided with a gas delivery tube, gives off a quantity of nitrogen, which may be collected over the pneumatic trough. By keeping the temperature constant, and collecting the gas evolved during successive equal intervals of time in similar cylinders, it is possible at once to show the regular diminution in the volume of gas which is caused by the constant diminution of the quantity of salt in solution. And by making the experiment and measuring the quantities of gas with accuracy, it would be possible to discover the relation between the amount of change going on at any moment, and the amount of salt in solution, and also, by making the experiment at different temperatures, to discover how the temperature of the solution affects the rate at which the action takes place.

The reduction of a permanganate by an oxalate in an acid solution furnishes another case of a gradual measurable change, and has been more fully studied. Here it is possible to start the change at any moment by adding the measured quantity of permanganate to the other ingredients, and mixing rapidly. It is also possible to stop it at any moment by adding a solution of iodide to the mixture; and the iodine which is set free by the action of the residual permanganate corresponds to it in quantity and can readily be estimated. By making a number of such experiments, differing from one another only in the time during which the gradual change is allowed to proceed, its course may be traced throughout with any required degree of minuteness. The results obtained in many series of such experiments are given in the "Philosophical Transactions for 1866," p. 206. The general conclusion to which they lead is that the total amount of change occurring at any moment is directly proportional, all other conditions being alike, to the amount of permanganate in the solution.

The last chemical change which has been investigated from this point of view, is that which takes place when dilute acid solutions of an iodide and a dioxide, such as barium or sodium dioxide, are mixed together. By arranging suitably the dilution, acidity, and temperature of the solution, the change may be made to proceed at any rate that is most convenient for measurement. One of the products of the change is iodine, a substance for which we have, in its action on starch, a most delicate test. By bringing a small known quantity of hyposulphite into the liquid all the iodine that is formed by the gradual reaction of peroxide and iodide is reconverted into iodide, and this continues till iodine enough has been formed to remove all the hyposulphite. As soon as the last particle of hyposulphite has been removed (converted into tetrathionate), free iodine appears in the solution, and the moment of its appearance may be noted by carefully watching the colour of the liquid. By adding successive quantities of hyposulphite, and observing the interval which elapses between successive reappearances of the blue colour of the iodide of starch, it is possible accurately to determine the rate at which the change is proceeding. An account of a number of experiments made in this way, and of their results, is to be found in the "Philosophical Transactions of 1867," p. 117. Each set of observations determines at what rate the dioxide is reduced, under certain conditions; and by making different series of experiments, in which the several conditions affecting the rate of change are systematically varied, it is possible to discover the laws of connection between each of the conditions and the amount of change. Having discovered these laws, our knowledge of the change is so far complete, and we can predict with certainty the time that would be required for any given amount of change under any given circumstances.

The following propositions embody the principal conclusions to which the examination of these cases of gradual chemical change has led:—

1. The rate at which a chemical change proceeds is constant under constant conditions, and is independent of the time that has elapsed since the change commenced.

2. When any substance is undergoing a chemical change, of which no condition varies, excepting the diminution of the changing substance, the amount of change occurring at any moment is directly proportional to the quantity of the substance.

3. When two or more substances act upon one another, the amount of action at any moment is directly proportional to the quantity of each of the substances.

4. When the rate of any chemical change is affected by the presence of a substance which itself takes no part in the change, the acceleration or retardation produced is directly proportional to the quantity of the substance.

5. The relation between the rate of a chemical change occurring in a solution, and the temperature of the solution, is such, that for every additional degree the number expressing the rate is to be multiplied by a constant quantity.—*Proceedings of the Royal Institution.*

ON THE

ESTIMATION OF SULPHUR IN IRON OR MINERALS BY MEANS OF A PLATE OF SILVER.

By M. W. EGGERTZ.

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1. *Iron.*

0·1 gramme of cast iron, wrought iron, or steel cut up or pulverised, and passed through a sieve with holes not larger than 0·6 m.m., is introduced by means of a glass or glazed paper funnel, into a flask about 0·15 metre high and 5 centimetres diameter, previously containing 1 grm. of water and 0·5 grm. of concentrated sulphuric acid, or in preference 1·5 grm. of sulphuric acid, sp. gr. 1·25, and whose volume (1·5 c.c.) has been marked on the flask.

A piece of polished silver plate (18 m.m. long, 7·5 m.m. wide, and 1 m.m. thick, with a hole at one end), composed of 75 per cent of silver, 25 per cent of copper, and attached to a thin platinum or silver wire, is quickly introduced into the flask, so that it may be a little below the neck; a cork is put in so as to hold the wire without completely closing it. It is allowed to stand fifteen minutes at the ordinary temperature, and the silver plate is then removed.

If the iron contains sulphur the plate is coloured by the sulphuretted hydrogen gas disengaged during the solution of the iron in the dilute sulphuric acid; and, according to the amount of sulphur present,[*] the colouration of the plate passes to a coppery yellow, a bronze brown, a bluish brown, or a blue. These colourations are determined with the greatest accuracy, especially that of the silver plate alone No. 1, that of coppery yellow No. 2, that of bronze brown No. 3, that of blue No. 4. The intermediate degrees may be represented by decimals thus: 2·5 if the colouration is between 2 and 3; 3·1 if the plate is one tenth towards the blue; 3·5 if it is as much blue as brown; 3·9 if the brown colouration is feeble.

As the normal colouration No. 2, we have adopted that of the bronze called yellow metal, newly rubbed with fine sand on leather (this metal consists of 60 parts of copper and 40 of tin). For the colouration No. 3, we have not been able to find a convenient alloy. A bronze, consisting of 85 parts of copper and 15 parts of zinc, does not quite represent the colour which should be obtained, for when freshly cleaned it is too bright, and at last takes a bluish colouration. For the colour in question it is better to use a plate of silver which remains in the flask during the solution of the iron, until it has become as brown as possible, and a slight bluish colour begins to be perceived; the plate is then removed and preserved in a well closed tube. The colour No. 4 resembles that of a watch spring. If the amount of sulphur is very considerable, this colouration passes to a clear bluish grey. By passing the plate of silver over a bottle of sulphide of ammonium the desired number can be easily obtained.

To obtain in these assays for sulphur, the proper tint on the silver plate, it is necessary to take certain precautions. The plate is to be held in pincers and cleaned as well as possible by rubbing it with a soft leather in which is placed a little very fine rotten stone. Contact with the fingers is avoided by means of a piece of paper, and the plate is to be carefully dried with a piece of filtering paper. If the plate by bleaching or by the action of the burnisher has been purified on its surface, this should be carefully removed by again rubbing with the leather, for pure silver is less sensitive to the action of the gas than that of the given standard. Thus it has sometimes been found that the silver employed for coinage furnishes less homogeneous plates, of which those parts richest in copper assume more quickly the blue colouration. On this account, the plates should be compared between themselves, by introducing them at the end of a wire into a flask in which is dissolving iron, containing from 0·05 to 0·08 per cent of sulphur. On introducing the plate, care must be taken not to turn the side but the edge against the strongest current of gas which would otherwise colour one face of the plate stronger than the other. The plate should be rapidly introduced into the flask after the introduction of the iron, as then a very strong disengagement of sulphuretted hydrogen immediately takes place. After a first experiment the flask is to be filled with water several times, so as to get rid of the odour of sulphuretted hydrogen. If a steel mortar is employed to pulverise the iron, the whole of the piece selected should be reduced to very fine powder. The mortar should be well cleaned each time, taking care to remove the disc from the bottom. Also the cloth, plates, and leather should be very clean; if the leather is not clean enough, the silver plate should be passed several times over a filter paper placed over the leather with a small quantity of rotten stone.

The changes in temperature between 15° and 25° C., seem to have no sensible influence on the colouration of the metal; if the temperature exceeds 40° the plate becomes moist and gives false indications.

Many experiments have been made on the white and the grey portions of cast iron; but when made separately these experiments have yielded identical results, although the metal dissolves in unequal quantities. If there is any difference it is that the white iron, being more difficult to dissolve, colours the plate a little more feebly.

There is no doubt that some practice is required to judge of the colouration of the plate, but it may be easily acquired. Generally the best plan is to place the standard plates of tints 1, 2, 3, &c., on a sheet of white paper by the side of the plate under experiment, exposing them to a good light near a window (but not sun light), and to examine them with a lens. The colourations between 2 and 4 are the most difficult to recognise; but with a little experience none will vary more than 0·1, so that, for instance, the colouration may be valued between 3·5 and 3·6

The following is somewhat an approximation between the different colourations upon the silver plate and the amount of sulphur as determined by my former process[*] in a great number of different irons:—

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[*] Selenium, when fused with iron, also gives a bluish colouration to the silver plate. Arsenic, antimony, and phosphorus in iron exert no influence in these experiments.

[*] See Chemical News, vol. 17, p. 291.

Number of the Colouration.	Per centage of Sulphur.
1·0	0·00
1·2	0·01
2·0	0·02
2·5	0·03
3·0	0·04
3·1	0·05
3·2	0·06
3·3	0·07
3·5	0·08
3·6	0·09
3·7	0·10
3·8	0·12
3·9	0·15
4·0	0·20

It is evident that in this way the exact quantity of the sulphur is not determined; but several years experience have shown that if these experiments are made with care, and the quantity of sulphur does not exceed 0·1 per cent, the results are near enough for all practical purposes. Iron which does not colour the silver plate will sometimes produce a colouration if we double the quantities of iron and acid. With half the quantities of acid and sulphurous iron, silver generally gives a little more than half the real quantity of the sulphur which is present. The sensitiveness of the silver plate may be augmented by moistening it with a solution of carbonate of ammonia, but the colouration becomes very unequal.

Amongst experiments on the estimation of sulphur in iron, the following deserve mention:—

1. The quantity of sulphur in wrought iron is often so small that it produces no colouration on the silver plate; this iron, therefore, not being red-short, may be employed for all kinds of uses. It must not, however, be forgotten that the quantity of sulphur is not equally distributed throughout a piece of iron, but that it may vary considerably in different places. On experimenting with the turnings obtained from a portion of an iron bar which was visibly red-short a stronger tint is often obtained on the silver plate, than when using other parts of the bar. The fragments obtained from red-short iron in boring a horse-shoe does not often give on the silver plate a deeper colouration than 2, and it appears to follow that ordinary wrought iron which contains 0·02 per cent of sulphur in certain parts cannot conveniently be employed for this purpose. If the red-short iron gives to the plate a slighter and more feeble colouration than 2, it may be supposed that the breaking is due less to sulphur than to an insufficient working of the cast iron, the crude pieces in wrought iron entirely free from sulphur often acting as if they were red-short. In general it appears certain that the quantity of sulphur in iron is more injurious when the iron has been badly worked. In a hard iron melted in a steel crucible, we may, in spite of its containing 0·04 per cent of sulphur, make holes like those in a horse shoe without any trace of cracks which may undoubtedly be attributed to the homogeneousness and good working of this iron. The quantity of phosphorus was only 0·03 per cent. The lower portion of an English rolled rail, without fault, contained 0·11 per cent of sulphur and 0·3 per cent of phosphorus; a portion was cut off which was so red-short that it could not be made use of.

Can the effects of sulphur and phosphorus in iron neutralise each other, and if so, in what degree? This is an old question which has lately been enquired into, and which deserves serious examination—an examination which will become easier when we have more ready means of estimating the quantity of sulphur and phosphorus in iron.

2. The richness in sulphur of steel of the best quality was, according to experiments made, such that the colourations on the silver plate varied only between 1 and 1·5. As in the case of wrought iron, the quantity of sulphur often varies in different parts of the same piece of steel, and that also appears to be the case in a little less decided a manner in fused steel.

3. The quantity of sulphur in cast iron is rarely so little as not to colour the plate. In the greater number of Swedish cast irons, this quantity is such that the silver plate varies in colouration between 2 and 3. In iron for gun castings it is between 3·3 and 3·7, and sometimes more. In cast iron the quantity of sulphur is often distributed unequally; there is generally more on the surface than is met with below.

If the colouration of the silver plate does not exceed 3 we can, according to many experiments, assume that the cast iron refined in the ordinary manner will not give red short iron, especially if the refining is done carefully. But as in different methods of refining different quantities of sulphur may be removed from the iron,* and in general more if the iron results from a light charge of the blast furnace, it cannot be said beforehand that all cast iron which communicates a bluish colouration to the plate will necessarily give red-short iron. It ought to be so, however, with cast iron which colours the plate as deep a blue as that of a watch spring. In cast iron which gives a red short wrought iron without rendering the silver plate more than brown, it is probable (the iron having been well refined) that the cause is owing to other substances than sulphur, but this occurrence is very rare.

Many circumstances appear to show that the quantity of sulphur in iron diminishes with time, at least on the surface, and under favourable conditions.

II. *Iron Minerals.*

The quantity of sulphur in a mineral cannot be estimated in the manner just described; all that can be done is to estimate the sulphur in the cast iron, which is obtained by reducing the mineral in a crucible, as described in *Jernkontoret's Annalen*, 1851, p. 56. Attention must always be paid to the following:—

A. That the powdered charcoal which fills the crucible is free from sulphur. This is ascertained by fusing iron, as free as possible from sulphur, in a crucible filled with the same powdered charcoal, and then examining the regulus obtained. If this latter gives a higher amount of sulphur than the iron originally contained, the cause is attributable to the charcoal. At Fahlun, the charcoal absorbs, in a short time, much sulphur from the smoke of the pyrites burning; and the powder selected for the crucible experiments in the Mining School is obliged to be kept in closed vessels. If the charcoal employed as a combustible in the crucible furnace is exposed to the action of much sulphuretted hydrogen, or sulphurous acid, the experiments show it.

B. The state of the mineral, whether unroasted, badly roasted, or well roasted. The small laboratory experiments, having for their object to ascertain how much sulphur can be removed from a mineral by roasting in bulk, are always inexact.

C. The influence exerted on the quantity of sulphur by the minerals mixed with it. It follows from many experiments made at the Mining School, that the more silicic acid the slag contains the more sulphur the cast iron receives, and that the quantity of sulphur gradually diminishes in proportion as the quantity of lime is increased.

We may here cite, as an example, the nature of the regulus, according to the mineral with which it has been reduced:—

With 15 per cent of quartz the regulus contained 0·09 per cent.

With 5 per cent of lime, the regulus contained 0·04 per cent.

With 20 per cent of lime, the regulus contained a little more than 0·01 per cent.

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* In the Bessemer process only very little sulphur can be removed.

The first slag was like enamel, the second was vitreous, and the third waxy. In general, assays for sulphur should be made with regulus obtained from a mixture containing as little lime as possible, but giving vitreous slags. If the colouration of the silver plate does not exceed No. 3, the quantity of sulphur may be considered as insignificant, especially in experimenting on non-roasted minerals.

The lime used in blast furnaces, may be assayed for sulphur in the following manner:—

Mix 0·8 gramme of rich and pure iron mineral with 0·2 gramme of quartz and 0·2 gramme of lime; fuse the mixture as usual in a crucible, and assay the resulting iron for sulphur. In this manner it may be ascertained if the lime contains an injurious dose of sulphur. If it were chemically pure we should obtain, by the addition of 2 or 3 per cent of clay or talc, free from sulphuric acid, a better slag. If, on the contrary, the lime contains much silicic acid, more than 0·2 gramme should be taken for the experiment.

EXPERIMENTS WITH COMMERCIAL ROSOLIC ACID, SO-CALLED AURINE CAKE.

By A. ADRIANI, M.D., Ph.D., &c.

My attention having been casually attracted to aurine cake, I felt induced to make some experiments with it in order to find out whether it would be possible to obtain from this material, pigments fit to be used as oil paints, chiefly for artists' use. None of the pigments I have obtained will answer for this purpose at all, since, on being mixed with even very clear linseed, nut, or poppy seed oil, the colours originally exhibited by the divers dry pigments, to be described hereafter, all change to very indifferent shades of dark stone-red colour, somewhat similar to oxide of iron paint.

I think it may not be quite superfluous to your readers to briefly enumerate the properties of rosolic acid. This acid was discovered by Runge, and is a product of the oxidation of phenol or carbolic acid in the presence of alkalies. It is a dark-coloured amorphous solid substance having a greenish lustre, yielding a red, or, in a very minutely divided state, orange-red powder; it cakes together at 60° Fahr., and melts at 212° to an almost black fluid, is not volatile, does not easily ignite on being heated, but when once so far heated, burning violently with a reddish, sooty flame; it is soluble in alcohol, in methyl-alcohol, soluble in ether (but not so freely as in alcohol), in carbolic acid, and in wood-creosote (Reichenbach's creosote), equally so in strong acetic, hydrochloric, and sulphuric acids; insoluble, however, in chloroform, benzol, sulphide of carbon, essential, and fixed oils. Rosolic acid is not decolourised by sulphurous acid; it is a very weak acid, weaker even than carbonic acid, unites with ammonia, fixed alkalies, alkaline earths, forming dark red compounds soluble in water and alcohol, and easily decomposed by air and light. Soluble rosolates do not form precipitates with salts of heavy metals. The percentage composition of rosolic acid is represented by: C 75.92, H 5.83, O 17.68.

In how far the so-called aurine cake applied by me for experiments is different from the chemically pure rosolic acid, I have had no opportunity to test; in its chief properties I have found the material I experimented with to correspond with the description of the properties of rosolic acid just alluded to.

Desirous to try whether I could not make the solution of aurine to unite intimately, or, rather, mix mechanically with a preparation of lead, I first dissolved some aurine in methylated spirit, next added to this solution an aqueous solution of acetate of lead, and afterwards just sufficient liquid ammonia to produce a precipitate of a highly basic acetate of lead, carrying along with it the aurine so intimately mixed therewith as to form a beautifully crimson-coloured precipitate; this I collected on a filter, and washed it with distilled water, but soon discovered that all the colour would be washed out if this process were to be continued; in fact, I was well aware that I had only to do with a very intimate mechanical mixture, and not, as is the case, for instance, with carmine lake obtained from cochineal by treating an aqueous solution of that colouring matter, first with a solution of alum, and next with carbonate of soda; I therefore stopped the washing, and dried the magma on a water-bath, afterwards reducing it to a very minutely-divided powder, by grinding it in an agate mortar. I next tried alum; *i.e.*, I dissolved some alum, free from iron, in water, and added to its solution a solution of aurine in carbonate of potassa; as I had foreseen, I did not obtain a real chemical compound, but again a very minutely-divided aurine dispersed through alumina. After a short washing of this, especially in a moist state, most magnificently scarlet-coloured substance, I again dried at 212°, and ground to impalpable powder as just mentioned; in a dry state, this powder exhibits a brilliant dark-orange hue of great brilliancy. I next became desirous to ascertain whether aurine possessed any affinity for recently-prepared phosphate of lime; I therefore dissolved some bone ash of good quality in hydrochloric acid, separated the sand and further insoluble in that acid by filtration, next precipitated by ammonia, collected and washed this precipitate well, and next dissolved the yet moist precipitate in dilute acetic acid; to this solution I added a solution of aurine in ammonia. I so obtained a very bright scarlet-coloured precipitate; but after having collected it on a filter, and commenced washing it, I soon found out that the aurine has not, unlike madder and other dry stuffs, affinity for phosphate of lime. I dried the precipitate obtained again at 212°, and reduced it to a minutely-divided powder afterwards; in a dry state it is still a beautiful pigment, and of an entirely different hue from the preceding. I next tried a solution of aurine in carbonate of ammonia, and precipitated it with chloride of barium; after repeating the process already described again, I obtained in this way a very brilliant flesh-coloured pigment. I mixed, in an earthenware glazed mortar, some aurine cake and strong baryta water, filtered this mixture, and added to the filtrate very weak sulphuric acid, just enough to neutralise the baryta; in this way I obtained a pigment which, after drying (of course some washing, but not to excess), can vie, in beauty and tone of colour with genuine carmine. I next proceeded to precipitate an aqueous solution of sulphate of zinc with a very slight excess of a solution of aurine in dilute caustic potassa, washing again, slightly, the precipitate, and drying it at 212°; the pigment so obtained has a fine rose colour. On trying sulphate of zinc again, but with a solution of aurine in dilute carbonate of potassa, after drying, a very peculiar and somewhat dull pinkish coloured pigment is obtained. A most magnificently bright scarlet of deep hue is obtained by first triturating together some previously separately-powdered aurine with lime-water (not milk of lime), filtering the turbid liquid, and next passing gently through it a current of carbonic acid gas. A precipitate ensues exhibiting the colour already referred to; on drying it, after having carefully collected it on a filter and slightly washed it, I find that even below 212° its colour is very much altered and impaired. I find, however, on instituting experiments on purpose, that if the pigments referred to are dried over sulphuric acid at the ordinary temperature, their primitive beauty, as seen on precipitation, and while yet moist, is to a very great extent preserved. As already stated, none of the pigments described are fit for oil colours—I have tried them, but none will do at all; but, undoubtedly, mixed with strong solutions of gum, free from acidity, or good size, or better yet, gelatine and albumen, these pigments might be of use in colouring paper hangings, toys, and other ornaments. As regards the solutions of aurine in weak fixed alkalies and their carbonates, from experiments I instituted, I think I may recommend aurine cake as an article for the manufacture of a red writing fluid—red ink—of great beauty. Of the solutions I tried for this purpose, I find that the solution in carbonate of soda answers best; this red ink can—firstly, be used with steel pens, not only not corroding them, but actually on account of the alkali protecting the steel from rust and corrosion; and, secondly, this ink would not affect blue-laid paper coloured with ultramarine, which latter pigment is decomposed by acids; and, since ordinary red ink is usually very acid, both the pens and paper suffer, if ultramarine blue-laid paper is used for writing. Another advantage of the use of the solution alluded to, instead of red ink, is that it may be safely used by mechanical draughtsmen with their steel drawing instruments, which will not suffer from its use. Tampering with what is written with the alkaline aurine solution, with acids for instance, will at once become evident by the writing becoming yellow, while the primitive colour cannot be restored.

I find that aurine cake is to some extent soluble in an aqueous solution of biborate of soda, yielding a solution of a brilliant scarlet-red hue; on writing with the said solution I found that, after drying, a very pale rose, or, when a more concentrated solution is used, an orange-coloured writing ensues. I prepared all these solutions at the ordinary temperature, by first pulverising the aurine cake in a stoneware or glass mortar, and next adding the aqueous alkaline solution, and rubbing it and mixing together for a length of time, and next filtering through good ordinary white filtering paper. Notwithstanding it is asserted that the colour from rosolic acid is very fugitive, I find that things written now, five, and even eight weeks ago, exhibit no signs of change or fading. Aurine in alkaline solution, far surpasses best red ink in brilliancy; if its asserted instability should, on a more severe and lengthy trial, prove incorrect, alkaline aurine solutions may be of use, also, instead of water colours for drawings, designs, and for mechanical and other draughtsmen, since the colour is extremely brilliant, and the raw material not expensive, considering its immense tinctorial power even in small quantity.

ON CONVENIENT FORMS OF EXPERIMENT WITH FLUID JETS.[*]

By Prof. FRANCIS H. SMITH.

The following descriptions of some serviceable forms of experiment with fluid jets may be of interest to a few of your readers:—

To obtain the water-jet, presently referred to, a small glass funnel was cemented to an opening in the bottom of a bucket. A valve was constructed by wrapping a 3 oz. leaden bullet with buckskin, and suspending it over the funnel from one end of a lever mounted upon the edge of the bucket. Placing the latter upon a tall tripod, and filling it with water, the operator has control of a satisfactory jet, which he can start and stop at pleasure. This rude apparatus leaves, perhaps, nothing further to be desired in the way of vertically falling jets.

Exp. 1. *Resolution of the jet.*—A large cylindrical beam of sunlight was introduced horizontally into the darkened chamber. The beam was condensed to a focus, with a double-convex lens. Between this focus and a screen, the jet of water was made to fall; a well defined shadow of the jet was thus thrown upon the screen, and it was easy to see a marked difference in the intensity of the shadow of the tranquil and troubled sections. Just at the focus referred to, was placed a circular disc of card-board, rotated by clock-work, and perforated all round, near its margin, with a number of equi-distant holes. When this was properly adjusted and set into rotation, the jet and screen were illuminated by a rapid succession of flashes of light.[*] Instantly the troubled section of the jet and its shadow was seen to be resolved into vibrating drops. When the flashes followed each other as fast as the drops, the shadows of the latter were stationary on the screen. If the velocity of the disc were now slightly reduced, the shadows slowly descended, and were seen to palpitate from prolateness to oblateness in a surprisingly distinct manner. If the disc be urged to greater speed, the shadows of the drops appear to ascend, according to a well known optical relation. It may be added, that by changing the relative distances of the jet and screen from the illuminating focus, we may make the shadows of the drops so large as to be seen without difficulty from the remotest parts of the largest lecture-room. I need not say that the electric lamp would furnish, in respect of steadiness, a better means of illumination than the sun.

This experiment was first tried by me in October, 1867, with a jet of quicksilver, strongly illuminated. The image of the jet was formed on the screen, and suitably interrupted at short intervals of time. The result was satisfactory, but was liable to the objections that the image was inverted.

Exp. 2.—The jet was chastened into greater regularity of structure by the sound of a monochord, tuned to tension, with it, or more simply by receiving its troubled section upon a resonant surface, so placed that its tremors were transmitted to the reservoir through the legs of the tripod. The phenomena before described were now more marked, the intermittent light enabling us to trace in detail the influence of the sound, in abridging the tranquil section of the jet, and causing incipient swellings and strictures high up upon the latter. The reflection of sonorous beats also may be more narrowly observed by this form of experiment.

Exp. 3.—The jet was received in its smooth section upon a polished circular metallic plate, considerably wider than the jet, and one of Salvart's liquid sheets, ten inches in diameter, was formed. When the unisonant monochord was sounded, the sheet was at once abolished. It was interesting to watch the resolution of the curved sheet of water, in the interrupted light, both with and without the aid of the neighbouring sound.

Experiments with like results were made with oblique and vertically ascending jets. In all cases the intermittent light invested the results with new interest and instruction. If I am not mistaken, the method here described is far preferable in simplicity, certainty, and ease of control, to that of electric flashes from the Leyden jar, whether used for research, or mere lecture-room illustration.

In reference to gaseous jets, allusion will at present be made only to sonorous flames in tubes.—*Am. Jour. of Sci., May*, 1868.

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[*] From a communication to J. D. Dana, dated University of Virginia, Feb. 20, 1868.

[*] When the disc is spinning very rapidly, the illumination of the screen seems to be continuous, but a white wand or string, or a fiddle-bow, shaken in the light, will demonstrate to the spectators its interrupted character. When the hand, with its fingers extended, is moved rapidly to and fro in the light, a monstrous appearance is presented which must be seen to be appreciated. The appearance also of a stretched cord vibrated transversely in the intermittent cone of light, is instructive. Its *apparent* wavings, the velocity of the perforated disc being kept uniform, change of course with the tension of the cord. When the vibrating cord appears stationary, its time of vibration is a multiple or sub-multiple of the interval of the flashes of light. As it is not difficult to decide this "indetermination," we have here, it appears, a method of determining the number of transverse vibrations per second of a tense cord.

FOREIGN SCIENCE.

Paris, July 8, 1868.

Researches on indium.—A new isomer of amylic alcohol.—The carbylamines.—A new alcohol, isomeric with caprylic alcohol.

Under the title of "Researches on indium," a valuable contribution has been added to the chemical history of this element. MM. Reich and Richter, in isolating the element, dissolved the oxidised blende or the zinc in hydrochloric acid, and submitted the chloride to distillation; this chloride they digested with a quantity of water insufficient to dissolve the whole; the acid residue was dissolved in water, the solution mixed with nitric acid, and supersaturated with ammonia. The precipitate, thus obtained, redissolved in acetic acid yields crude sulphide of indium. M. Winkler's paper refers (1) to the occurrence in nature of indium, (2) to the extraction of the metal, (3) to its properties, (4) to the equivalent, and (5) to its combinations. No mineral is at present known which contains a notable quantity of indium; the only blendes in which the element has been as yet observed are the Freiberg blende and the black blende of Breinteinbrunn, or *christophite*, which contains 0·0062 per cent of indium. The extraction of indium from the blende is a tedious operation. The powdered mineral is submitted to a thorough roasting at dull redness; the roasted product contains much sulphate of zinc, nearly all the indium in the state of sulphate, but very few other soluble metallic salts. By dissolving out the soluble matters a clear liquid, slightly ferruginous, is obtained, from which metallic zinc separates the indium, as well as copper, cadmium, &c. Only traces of indium are contained in the residue after washing. The process just described is the most advantageous one when operations are made on a large scale, but in other circumstances, to work upon the Frieberg zinc is more convenient. The metallic zinc is treated by dilute sulphuric acid, in insufficient quantity to dissolve the whole. After several weeks' contact, or by ebullition with excess of zinc, there is formed a spongy metallic residue, which amounts usually to 2 per cent of the weight of zinc employed, and which contains lead, copper, cadmium, arsenic, and indium; the indium constitutes about 2 to 2·5 per cent of this deposit. Thus 10 kilogrammes of zinc gave M. Winkler 208 grammes of metallic residue, containing 4·312 grammes of indium. To extract the indium from this deposit, concentrated sulphuric acid is added, and a sufficient heat applied to expel the excess of acid; the result is a grey pulverulent mass, which, after calcination in a crucible, becomes quite white. By digestion in water the sulphates are dissolved, with the exception of sulphate of lead. By precipitating the filtered liquor with ammonia, the impure hydrate of indium is obtained; this precipitate is redissolved in the smallest possible quantity of hydrochloric acid, sulphurous acid added to reduce the iron to the minimum state of oxidation, and the solution digested with carbonate of baryta, which precipitates the whole of the indium after sufficiently long contact. MM. Reich and Richter originally fixed the equivalent of indium at 37·2, while M. Winkler found the figure 35·8. New determinations have led him to adopt the number 37·8. One method he employed consisted in determining the amount of gold set free by the action of metallic indium on chloro-aurate of sodium. As a verification, a weighed quantity of indium was dissolved in nitric acid, and the weight of oxide of indium obtained by calcination of the nitrate determined. Indium forms a suboxide, which is obtained by an incomplete reduction of the oxide by hydrogen. By placing the bulb in a bath of melted paraffine, the phases in the reduction may be observed. About 190°, the oxide of indium becomes green, or bluish green, at the same time that water is formed; at 220° to 230° the oxide becomes grey; and about 300° it remains as a black mass, at the same time that the evolution of water ceases, only to recommence at a much higher temperature. The black mass thus obtained contains metallic globules. Separated from these metallic particles, the black mass constitutes suboxide of indium; it is pyrophoric when heated, and is transformed into oxide by combustion. The composition of this oxide is expressed by the formula In_2O. The intermediate phases through which the oxide passes are possibly due to combinations of oxide and suboxide; thus the green product obtained at 190° contains $In_7O_6 = 5InO + In_2O$; and the grey product, which is formed about 230°, possesses the formula $In_6O_5 = 4InO + In_2O$. When indium is heated to a temperature considerably above its fusing point, a grey pellicle of suboxide is formed, which finally takes a yellow tint; heated to redness the metal burns with a violet flame, and brown fumes of oxide are produced. The colour of oxide of indium is yellow, but at a red heat it is brown; the normal colour is reassumed on cooling. Oxide of indium appears to be infusible and fixed; it contains 82·53 per cent of indium. The salts of indium are in general soluble and difficultly crystallisable; they are colourless. The following are the characters exhibited by their solutions:—Ammonia—white precipitate soluble in excess; tartaric acid impedes the precipitation. Potassa or soda—white precipitate, soluble in excess, but soon separating again from the solution. Carbonate of ammonia—gelatinous white precipitate, soluble in excess, but separated again by ebullition. Carbonate of soda—precipitate insoluble in excess. Carbonate of baryta—complete precipitation of indium as carbonate or oxide. Phosphate of soda—gelatinous white precipitate, dissolved by potassa solution with great ease. Sulphuretted hydrogen—yellow or white precipitate of sulphide of indium; the precipitation is complete in alkaline solutions, partial in neutral or slightly acid solutions, *nil* in strongly acid solutions; in presence of acetic acid the sulphide is completely precipitated. Sulphide of ammonium—voluminous white precipitate. Oxalic acid—crystalline precipitate in neutral and concentrated solutions. Ferrocyanides—white precipitate; ferridcyanides and sulphocyanides, no reaction. Neutral chromate gives a yellow precipitate; the bichromate no precipitate. The hydrate of indium produced by ammonia, when dried in the air, contains 5InO, 6HO; but when dried at 100°, its composition is expressed by the formula InO, HO.

At the *séance* held on the 15th of June the following memoirs were communicated:—"On a new isomer of amylic alcohol," by M. Wurtz; "On a new alcohol, isomeric with caprylic alcohol," by M. de Clermont; "On the carbylamines," by M. Gautier; "Researches on Chlorophyl," by M. Filhol; "Researches on the combustion of oil: analyses of the gaseous products of the combustion of the oil from the basin of Saarbruck," by MM. Scheurer-Kestner and Mounier. M. Saix addressed a rectification to the "Theory of the pile," which he lately communicated; and M. de la Rive addressed a letter to M. Dumas, "On the theory of the phenomenon discovered by Faraday, of rotatory magnetic polarisation."

By reacting with iodide of amyl upon zinc ethyl, M. Wurtz obtained some years ago a hydrocarbon possessing the composition and the principal properties of amylene; the hydrocarbon referred to is ethyl-allyl, C_5H_{10}. The hydriodate of this body, however, boiled at 147°, while the same compound of amylene boiled at 129°. Hydriodate of amylene, it is well known, is attacked and completely decomposed, at the ordinary temperature, by oxide of silver in presence of water; the hydriodate of M. Wurtz's hydrocarbon is only incompletely attacked, behaving, under these conditions, like iodide of amyl. When one distils completely, there passes in both cases a liquid denser than water, which still contains iodine, and which, nevertheless, exhales an odour of amylic alcohol. Acetate of silver is attacked more easily by hydriodate of ethyl-allyl. The silver salt is suspended in anhydrous ether, an equivalent proportion of hydriodate added, and at the end of twenty-four hours the mixture is distilled. Above 100°, an acid liquid distils, which contains acetic acid, and an acetate correspond- to the hydriodate of ethyl-allyl. To isolate this acetate, the liquid is agitated with carbonate of soda, the oily layer desiccated with chloride of calcium, and distilled. The acetate comes over from 133 to 135°; it is a colourless liquid possessing an aromatic odour, which, at the same time, is not that of acetate of amyl. Potash decomposes it into acetate and isoamylic alcohol. Some of this alcohol was digested at the ordinary temperature with permanganate of potassium; distillation gave a small quantity of a neutral volatile liquid, which was treated with bisulphite of sodium. The crystals formed were compressed between blotting paper, and decomposed by distillation with carbonate of soda. A small quantity of a liquid, possessing an aromatic odour, and boiling about 103°, was obtained. This liquid, upon an analysis, gave $C=68{\cdot}48$, $H=11{\cdot}78$; the formula $C_5H_{10}O$ requires $C=69{\cdot}76$, $H=11{\cdot}16$. This analysis, and the boiling point, prove that a small quantity of acetone is formed by oxidation with permanganate; a mixture of acetic and propionic acids is also formed. The liquid from which the acetone was volatilised having been filtered and supersaturated with sulphuric acid yielded, upon distillation, an acid liquid, which was converted into a silver salt. This salt was found by analysis to contain $C=17{\cdot}69$, $H=1{\cdot}06$. Experiments were also made with chromic acid, and they have shown that, under the influence of oxidising agents, isoamylic alcohol (hydrate of ethyl-allyl) gives first an acetone, and afterwards splits up into propionic and acetic acids. When iodide of isoamyl is treated by acetate of silver in presence of ether, a certain amount of isoamylene (ethyl-allyl) is set free, and distils with the ether; a bromide produced therefrom, passed over from 170° to 180°. This bromide, having been heated with sodium to 100° for some days, yielded the hydrocarbon in the free state again. The hydriodate was again formed by heating the hydrocarbon with hydriodic acid. The hydriodate thus formed was identical with the hydriodate of ethyl-allyl: it distilled over at 145°. One would conclude from this, M. Wurtz says, that the ethyl-allyl set free by the decomposition of the hydriodate, maintains its atomic grouping intact, not only after having been converted into bromide, but even after being deprived of its bromine by sodium. The alcohol described is the third isomer of the primary hydrate of amyl; the two others being the hydrate of amylene, discovered by M. Wurtz, and the secondary alcohol, obtained by M. Friedel, by adding hydrogen to methyl-butyl.

The experiments of M. de Clermont were made in the laboratory of M. Wurtz. M. de Clermont first describes hydriodate of caprylene. When caprylene is heated with a solution of hydriodic acid, saturated at zero, this compound is produced; at the end of a few hours the reaction is completed, and the hydriodate is found as an oily liquid at the bottom of the vessel. The layers being separated, the product is washed first with water, afterwards with a weak solution of potash, and then dried over chloride of calcium. This liquid is submitted to fractional distillation *in vacuo*, that, coming over at 120°, constitutes pure hydriodate; the specific gravity of this distillate is 1·33 at zero, and 1·314 at 21°. By reacting in the same way with hydrobromic acid, the hydrobromate of caprylene is obtained. When hydriodate of caprylene is added to acetate of silver suspended in ether, a lively reaction ensues; iodide of silver is formed, as well as a certain quantity of caprylene and acetic acid, but a compound also, the acetate of caprylene, is obtained. Ether dissolves the fluid products. By distillation, the ether is removed; the residue is treated with water and carbonate of soda to remove the acetic acid, and dried by chloride of calcium. A liquid is thus obtained, from which the caprylene is eliminated by fractional distillation; finally, pure acetate of caprylene is obtained. It is a colourless liquid, possessing a fruity odour; its density at zero is ·822, and at 26°, ·803; its boiling point is inferior to that of the acetate of capryl of M. Bouis, which is 193°. Upon distilling in the oil-bath acetate of caprylene with an equivalent quantity of caustic potash, recently calcined, acetate of potash and hydrate of caprylene are obtained. The distillate requires rectification. The hydrate purified by fractional distillation was analysed, and the figures obtained led to the formula $C_8H_{18}O$; the liquid upon which the analysis was made boiled at 174° to 178°. The hydrate of caprylene is a transparent, colourless, and very mobile liquid, not oily, and possessing an aromatic odour and a burning and persistent taste; it is inflammable, and burns with a bright flame. It is insoluble in alcohol and ether; its density at zero is ·811, and at 23°, ·793. Hydrochloric acid does not appear to decompose the hydrate of caprylene; but the solution of hydrochloric acid, aided by heat, gives birth to the hydrochlorate of caprylene. This hydrochlorate would be a new isomer of the chloride of capryl of M. Bouis, another having been described by M. Schorlemmer,[*] which he obtained in treating amyl-isopropyl with chlorine.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Detection of Nitroglycerine.—To detect nitroglycerine in cases of poisoning, A. Werber proceeds in the following manner;—The organic material to be tested is extracted with ether or chloroform, the extraction mixed on a watch glass, with two or three drops of pure aniline, and evaporated upon the water-bath. A few drops of concentrated sulphuric acid are then added, when, if nitroglycerine is present, a purple colouration appears which changes to a dark green on dilution with water. As little as ·001 grain of nitroglycerine may thus be identified.—(*Schmidt's Jahrb. d. ges. Med.*, 1867; and *Zeitschr. Analyt. Chem.*, vii., 158.)

Dinitronaphtol.—C. A. Martius.—Chlorhydrate of diazonaphtol, $C_{10}H_6N_2$, HCl, is formed by the action of potassic nitrite upon a diluted and acid solution of chlorhydrate of naphthylamine, $C_{10}H_9N$, HCl. If a solution of chlorhydrate of diazonaphtol is mixed with nitric acid and boiled, a violent reaction takes place, during which nitrogen is set free, and on cooling, yellow crystals separate, which consist principally of dinitronaphtol, $C_{10}H_6(N\Theta_2)_2\Theta$. The formation of this compound is illustrated by the following equations:—

$$C_{10}H_9N,\ HCl + NH\Theta_2 = C_{10}H_6N_2,\ HCl + 2H_2\Theta$$
$$C_{10}H_6N_2,\ HCl + H_2\Theta = C_{10}H_8\Theta + N_2 + HCl$$
$$C_{10}H_8\Theta + 2NH\Theta_3 = C_{10}H_6(N\Theta_2)_2\Theta + 2H_2\Theta.$$

Dinitronaphtol is almost insoluble in boiling water, difficultly soluble in alcohol, ether, or benzol. It is a strong acid decomposing carbonates readily. Reducing agents convert it into a basic compound of the composition $C_{10}H_6(NH_2)_2\Theta$ as described by the author and P. Greiss (*Ann. Chem. Pharm.*, cxxxiv., 375). Dinitronaphtol is a valuable yellow dye, and is now extensively used as such. (*Akad. z. Berlin*, 1867.)

New Synthesis of Aceturic Acid.—N. Tazukowitsch.—The action of chloracetic acid upon benzamide gives rise to the formation of hippuric acid, as described by the author on a previous occasion (*vide* Chemical News, No. 411, p. 208). In a similar manner aceturic acid may be obtained by acting with chloracetic acid upon acetamide, as shown in the following equation:—

$$C_2H_3Cl\Theta_2 + N\begin{cases} C_2H_3\Theta \\ H_2 \end{cases} = C_2H_3\Theta.NH.(C_2H_3\Theta_2) + HCl.$$

In order to avoid the injurious action of the free HCl, an excess of acetamide has to be taken, when NH_4Cl will be formed instead of HCl:

$$C_2H_3Cl\Theta_2 + 3(C_2H_3\Theta.NH_2) = C_4H_7N\Theta_3 + (C_2H_3\Theta)_2HN + NH_4Cl.$$

Chloracetic acid and acetamide have to be heated together to 150-155° C. for three hours. The liquid portions are then poured off from the crystals and mixed with an excess of ether, which causes an oil to separate. The aqueous solution of this oil is neutralised with calcic carbonate, and from the calcic aceturate the acid is liberated by adding an equal proportion of oxalic acid.—(*Zeitschr., Ch.*, N.F., iv. 79.)

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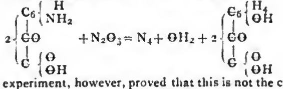
[*] *Annalen der Chem. u. Pharm.*, cxliv., p. 190; 1867.

Dibromide of Cholesterin.—W. Moldenhauer and T. Wislicenus.—Well purified cholesterin, dissolved in carbonic disulphide, and treated with bromine until the latter ceases to disappear is converted into a dibromide, $C_{26}H_{44}\Theta Br_2$. This compound, which is insoluble in water, is readily purified by recrystallisation from a mixture of alcohol and ether. On reduction with sodium-amalgam no substitution of bromine by hydrogen takes place, but cholesterin is regenerated. (*Naturf. ges. Zürich.*, 1867, 166).

Preparation and Determination of Cantharidin.—A. Fumouze.—Powdered cantharides are macerated with chloroform for twenty-four hours, and this treatment is repeated twice with fresh quantities of solvent, the residue having been well squeezed each time. The collected solutions are then distilled, and the dark green residue treated with carbonic disulphide which dissolves fatty, resinous, and other matters, and precipitates the cantharidin. The precipitate is thrown on a filter, washed with carbonic disulphide, and recrystallised from chloroform. The same process, omitting the final recrystallisation, may be used for the quantitative estimation of cantharidin in cantharides. The average quantity found was from four to five grammes in one kilogramme (*Journ. Pharm.*, vi. 161).

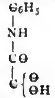
On the Probable Identity of Methylic Aldehyd with Dioxymethylene.—A. Geuther.—Hofmann in his researches on methylic aldehyd (*Comptes R.*, lxv., 555.), mentions a crystalline body of the composition CH_2S, which he obtained by treating the original liquid with sulphuric hydride, and boiling the oil thereby formed with chlorhydric acid. The composition of these crystals and their properties, as described by Hofmann, are identical with those of a compound first discovered by Girard as a product of reduction of carbonic disulphide, and afterwards obtained by A. Flusemann from ethylenic sulphide by heating to 150° C., and called by that chemist dimethylenic sulphide. Should the compound of Hofmann be identical with dimethylenic sulphide, the existence of methylic aldehyd amongst the products of oxidation of methylic alcohol would become doubtful in proportion as that of dioxymethylene would gain in probability (*Zeitschr. Ch.*, N.F. iv., 159).

Oxanilic Acid.—A. Claus has investigated the reaction between nitrous acid and oxanilic acid, in order to decide the question whether the two carbon nuclei of the latter acid—that of oxalic acid on the one hand, and that of aniline on the other—are held together by direct union, or through the interposition of the nitrogen atom. If the former alternative is the correct one, the action of nitrous acid will confine itself to the group NH_2, and the formation of an oxyphenyloxalic acid must be expected :—



$$2\left\{\begin{array}{l} C_6\left\{\begin{array}{l}H\\ NH_2\end{array}\right.\\ \,| \\ CO \\ \,| \\ C\left\{\begin{array}{l}O\\ OH\end{array}\right.\end{array}\right. + N_2O_3 = N_4 + OH_2 + 2\left\{\begin{array}{l} C_6\left\{\begin{array}{l}H_4\\ OH\end{array}\right.\\ \,| \\ CO \\ \,| \\ C\left\{\begin{array}{l}O\\ OH\end{array}\right.\end{array}\right.$$

The experiment, however, proved that this is not the case; but, accompanied by a copious evolution of nitrogen, a complete dissolution takes place, ending in the formation of carbolic and oxalic acid. The atomic constitution of oxanilic acid, therefore, must be regarded as—



$$\begin{array}{l} C_6H_5 \\ \,| \\ NH \\ \,| \\ CO \\ \,| \\ C\left\{\begin{array}{l}O\\ OH\end{array}\right.\end{array}$$

—(*Journ. pr. Chem.*, ciii., 54.)

Conversion of Organic Chlorides into Iodides.—A. Lieben.—The method for converting organic chlorides into iodides, which is applicable in many cases, is based on the fact that double decomposition takes place when an organic chloride is treated with concentrated iodhydric acid. Thus ethylic chloride, heated with IH of 1·9 sp. gr. in a sealed tube to 130° C., is readily converted into iodide. On the other hand, ethylic iodide may be reconverted into chloride, though extremely slowly and imperfectly, by heating with chlorhydric acid. Chloroform and iodhydric acid, at 130°, give iodide of methylene and free iodine :

$$CHCl_3 + 3IH = CHI_3 + 3HCl$$
$$CHI_3 + IH = CH_2I_2 + 2I.$$

The method is less successful in the case of aromatic chlorides, on account of the high temperatures required to start the reaction, temperatures at which the iodides cannot exist.—(*Akad. Wein. aud. Journ. pr. Chem.*, civ., 59).

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, July 6, 1868.

Sir H. Holland, Bart., F.R.S., in the Chair.

John Glas Sandeman, Esq., was elected a Member of the Royal Institution.

The Managers announced, that, in conformity with the Deed of Endowment, they had appointed William Odling, Esq., M.B., F.R.S., Fullerian Professor of Chemistry, in the room of the late Professor Faraday.

The Presents received since the last meeting were laid on the table, and the thanks of the members returned for the same.

NOTICES OF BOOKS.

SWEDENBORG AS A MAN OF SCIENCE.*

The Rev. Charles Kingsley, Professor of Modern History in the University of Cambridge, asserts in his *Miscellanies*,† that—

"The world only knows Swedenborg as a dreaming false prophet, forgetting that if even he was that, he was also a sound and severe scientific labourer to whom our modern physical science is most deeply indebted."

Are there any grounds for this assertion? Is our modern physical science most deeply indebted to Swedenborg? If so, in what particulars?

From his youth, Swedenborg took a lively interest in general science, and his mind teemed with speculations, theoretical and practical. He was offered the Professorship of Mathematics at Upsala, which he declined. "It is the fatality of mathematicians," he wrote, "to abide in theory. I have often thought it would be a capital thing, if to each ten mathematicians one good practical man were added to lead them to market; he would be of more use and mark than all the ten." Charles XII. employed him in military engineering, and in 1716 appointed him Assessor in the College of Mines.

Up to 1722 he was an industrious pamphleteer, writing on docks, sluices, and salt-works, on the manufacture of tin-plate, on improved stoves, on decimal measures and coinage, on algebra, on finding the longitude at sea by the moon, on the decrease of the rapidity of the earth's rotation, on the tides of the ancient world, on chemistry, geology, &c., &c. Throughout all his discussions he displays a sagacious intellect, never whimsical, bold, yet true to common-sense. For instance, reasoning on chemistry, he asks, "What is there in nature which is not geometrical? What is the variety of experiments in chemistry, but a variety of position, figure, weight and motion in particles?" and then goes on to assert that chemical combinations can be nothing but the re-arrangements of variously-shaped atoms. The experiments wherewith he illustrated his doctrine are, in our light, crude and absurd, but the conjecture was one with which Dalton would have sympathised.

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* *Emanuel Swedenborg: His Life and Writings.* By William White. Second edition, in one volume. London, 1868.

† Review of Vaughan's *Hours with the Mystics.*

For twelve years from 1722 he printed nothing, but in 1734 amply accounted for his silence by the publication of three noble folios entitled *Opera Philosophica et Mineralia*. The second and third of these are practical and technical, giving an account of iron and copper mining, and the processes of manufacture in use last century. His disclosure of trade secrets was resented, but he argued, "Why should facts be withheld from this enlightened age? Whatever is worth knowing should by all means be brought into the great and common market of the world. Unless this be done, we can neither grow wiser nor happier with time." These volumes have an abiding value as records of methods in use last century: as Dr. Percy observes, "The metallurgical works of this remarkable man seem to be very imperfectly known—at least they are rarely if ever quoted; and yet none in my judgment are more worthy of the attention of those interested in the history of metallurgy."[*]

The first volume, entitled, *Principia, or the first principles of natural things, being new attempts towards a philosophical explanation of the Elementary World*, constitutes Swedenborg's most characteristic claim to attention. An English translation in two volumes was published by the Rev. Augustus Clissold in 1845-46.

The *Principia* is an endeavour to explain the origin and method of creation. Nature is asserted to start from "points of pure and total motion produced immediately from the Infinite," which motion is said to be vortical.

From the congress and compression of points are formed what he calls first finites, revolving on their axes under the impulsion of their constituents; in this respect perfectly resembling the earth, although in comparison with the least things visible they are quite inappreciable.

Out of first finites by still further compression are formed second finites, which are said to constitute the first element, filling the whole space of the stellar heavens and composing the solar vortex.

From second finites by yet further compression are produced third finites, which constitute the magnetic element.

Again third finites are compressed into fourth finites, or the third element called ether.

Ether under further compression becomes air, and air compressed becomes water, and water under similar treatment yields salt and all minerals.

Such, according to Swedenborg, is the derivation and procession of the elements. Derived from the original point is a ceaseless motion, whereby all subsidiary matter is maintained in vortical whirl.

For the confirmation of the theory he turned to the phenomena of magnetism. Professor Musschenbroek, of Utrecht, had published in 1729 *Physicæ Experimentales et Geometricæ Dissertationes* abounding in magnetic observations. These Swedenborg freely transferred to his pages, and applied them in proof of vortical motion. Musschenbroek held that magnetic attractions and repulsions observed no certain laws: Swedenborg on the contrary maintained that nowhere was order more demonstrable.

A cardinal principle with Swedenborg was the uniformity of creation—that size makes no difference; that the method of Nature is everywhere the same; that the energy that shapes a dew-drop shapes a world; that the mechanism of the trunk of an elephant and a fly is the same. This truth he considers of inestimable value, because by analogies drawn from the seen we may predicate the unseen, and deal with it as though it lay under our eyes.

Consistently, then, he applies his doctrine of atomic to cosmic creation. Suns are sires of systems; suns therefore consist of points of motion produced from the Infinite. The condensation of these points results in ether, which thrown off from the sun, breaks by attenuation, and collapses in planets; which spheres of ether by slow degrees condense to air, to water, to salt, to *terra firma*.

So pleased was Swedenborg with this conception that he expanded it in a romance entitled the *Worship and Love of God*, wherein he pursues the story of creation through flora and fauna to Adam and Eve.

His next undertaking was a search for the human soul in the body. He determined to allow himself no rest until he had discovered and demonstrated its existence, and for this purpose devoted several years to the study of anatomy. In 1741 he published the *Economy of the Animal Kingdom*, and in 1745 the *Animal Kingdom*, which he left unfinished. These works are simply physiological studies—a grouping and discussion of the facts of the anatomists as preliminary to his quest.

About 1744, in his 56th year, occurred the great mental convulsion which converted him to spiritualism—to a professed familiar of angels and devils. With that phase of his character we do not meddle. Our concern is to appraise his scientific import.

First it is to be remarked, that his books do not appear to have had any popularity. There is no evidence of their influence on his generation. He dropped them himself, considering he had outgrown them, and some of his acquaintances in later years scarcely knew of their existence. They were revived in English by the Swedenborg Association in 1845-47, but only to lapse once more into oblivion.

What then are Swedenborg's claims as a man of science? We should answer, in any eminent sense, none whatever. He was well informed; he was abreast of the science of his time, but did nothing to extend it. He was a theorist, and rarely, if ever, an experimentalist. It is said Buffon possessed a copy of his *Principia*, and as Laplace owns that Buffon first suggested to him the derivation of earths from suns, it is presumed Buffon derived the idea from Swedenborg. Suppose he did: at the best it is a small matter. The unity of creation with the probability that all things proceed from one thing, is a notion old as philosophy. Again it is urged, Faraday conjectured that all matter might finally be reduced to forms of energy, and that is Swedenborg's notion. True; but Faraday's merit lay not in the conjecture, but in the original and ingenious experiments wherewith he supplied evidence for the conjecture. Again, in one place Swedenborg speaks of seven planets when only six were known; therefore, it has been asserted, he predicted the existence of Uranus. So likewise did Sterne when he made Dr. Slop ask "Are there not seven wonders of the world? seven days of creation? seven planets? seven plagues?" The mystic value assigned to seven was the origin of the planetary and other numbers.

Were Swedenborg's theories even more suggestive, we should dismiss such claims as happy guesses among numerous errors. Indeed, how is it possible for any mind of sagacity and experience like his to speculate extensively without occasionally drawing near to truth? but the merit of the theoriser is of small account inasmuch as he never knows when he is near and when remote from truth. Students of bygone scientific philosophy are continually surprised with hints which modern research has converted into verities. As Sir Henry Holland, writing of Dalton and the Atomic Theory, observes, "Certain questions as to priority of discovery meet us here, even at the outset. This, it is well known, has happened in almost every similar case. In the history of the greatest discoveries (even that of universal gravitation) we find the record of men who have seen the light before them, have approached near to it, but have missed the sole path by which the lamp could be seized." We do not depreciate theory: conjecture must always precede intelligent discovery; but we must reserve the honours of science for those who reduce conjecture to truth by the evidence of experiment.

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[*] Metallurgy by John Percy, M.D., part i., p. 439.

CORRESPONDENCE.

NOTES ON OZONE DEVELOPMENT DURING APRIL, MAY, AND JUNE, 1868.

To the Editor of the Chemical News.

Sir,—I beg to forward the enclosed "Notes on Ozone Development" during the past three months:—

Large Amounts.—April 2nd (aft.), 8th(morn.), 18th (aft.), 19th, 22nd (morn.), 23rd (morn.), 24th, 25th (aft.), 28th; May 1st (morn.), 5th (morn.), 10th (aft.), 11th, 17th, (aft.), 22nd, 23rd, 24th (aft.), 29th (morn.), 31st; June 1st, (aft.), 4th, 22nd. *Small Amounts*—April 13th (aft.), 15th, (morn.)16th; June 5th (morn.), 12th (morn.), 19th (aft.) 26th (morn.), 28th (morn). *No Ozone was found*—April 9th (aft.), 10th (aft.), 11th, 12th, 17th (morn.), 20th (morn.); June 29th (morn.)

The greatest change in ozone development between any two consecutive days occurred between the 19th and 20th of April. Considerable changes also occurred between the 8th and 9th of April, the 4th and 5th of June, and the 18th and 19th of June.

Ozone development was extremely variable throughout the day on April 15th, 21st, 27th—30th; May 1st—5th; June 20th—22nd; and variable throughout the day on April 13th, 14th; May 24th, 25th; June 5th—8th, and 14th.—I am, &c.,

R. C. C. Lippincott, F.M.S.

Highcliff House, Eastbourne,
July 3rd, 1868.

DEATH FROM CARBOLIC ACID.

To the Editor of the Chemical News.

Sir,—Allow me to add my opinion to Messrs. F. C. Calvert and Co.'s, that the jury's verdict on the cause of Mr. Berger's death is an error, and that the gentleman must have died from drinking carbolic acid, and not from inhaling it.

The only complaint that my assistants make, from constantly inhaling carbolic acid, is that of increased hunger.

I have been continually experimenting with carbolic acid for more than a year, and practising its inhalation upon myself, sometimes to intense inconvenience, and I can scarcely think it possible to cause death in that way.

It may be painful to the friends of this excellent gentleman, to be told that he must have drunk carbolic acid; yet the accuracy of this fact is important to the last degree, lest an insane prejudice should be created against the use of carbolic acid, just as its marvellous effects in consumptive cases, skin diseases, &c., are beginning to be generally known.

Neither new nor old remedial agents should be used indiscriminately. Excess can never be made the rule of life, and they who try excess must suffer.—I am, &c.,

T. A. Readwin.

108, Dorset Street, E.C.

MISCELLANEOUS.

Chemical Promotions.—There is some stir in the chemical world *àpropos* of existing vacancies and probable promotions. Unfortunately the number of remunerative offices which can be held by scientific chemists in this country is small, and the emoluments, for the most part, are absurdly insufficient. That accomplished chemical pluralist, Dr. Frankland, having resigned one of the least lucrative of his positions, Dr. Odling will succeed him—whether wholly or in part, seems not quite clear. Dr. Odling will, we believe, associate with himself a co-lecturer at St. Bartholomew's Hospital; and this will probably create a vacancy in the chemical chair of another metropolitan medical school. Dr. Lyon Playfair will also, it is understood, vacate the chemical chair in the University of Edinburgh, in the case of his election to represent the University in Parliament. It is expected that he will be succeeded by Dr. Anderson, Professor of Chemistry in the University of Glasgow.—*British Medical Journal.*

[The above paragraph is not quite correct. Dr. Odling has been appointed Fullerian Professor of Chemistry at the Royal Institution; not, however, *vice* Dr. Frankland, resigned, but in the place of the late Professor Faraday. Dr. Odling's co-lecturer at St. Bartholomew's Hospital will be Dr. Matthiessen; and the vacancy which this will occasion at St. Mary's will probably be filled up by Dr. Russell.]

Something like a Lecture!—In a recent number, we published a paper, by Professor Henry Morton, Ph.D., describing some highly interesting experiments which had been found to obviate the difficulties attending the production of monochromatic light in large quantities. Dr. Morton has since carried out his method on a grand scale, and with perfect success, at the Academy of Music, Philadelphia, before an audience of about 3,500 persons. Our space will not allow us to give a long report of the lecture; we must, therefore, content ourselves with merely referring to some of the experiments which were most novel and effective. The amount of apparatus employed was something extraordinary. There were ninety Bunsen's burners, five lime-lights, a galvanic battery of great power, an oxyhydrogen blow-pipe and two large cameras, induction coil and electric-wheel, screens and mirror, eight gas-bags, two hydrogen generators, and a large iron reservoir, holding 72 gallons of oxygen. It required fifteen assistants to work the apparatus, and forty young gentlemen from the University to represent the spectrum. To show that the temperature of the sun resembled that of the oxyhydrogen blow-pipe, the lecturer placed himself and apparatus on a platform secured to one of the stage traps, and then was raised to a great height above the floor, at which elevation he burned in the compound blow-pipe a piece of thick steel-wire rope. The fountain of scintillating sparks and drops of melted steel, descending in a broad sheet some 15 feet in height, poured upon the stage, and rolled in a torrent of fiery hail towards the footlights; proving to the audience that the metal was reduced to the gaseous condition in which it exists in the sun. A wheel, 5 feet in diameter, composed of Geissler tubes, was rotated, while flashes of electric light, produced by the large induction coil constructed for the University of Pennsylvania, produced the effect of a star darting innumerable coloured and constantly-changing rays. The stage was then illuminated with a number of lime-lights; a procession was formed of brilliantly-costumed figures, personating the prismatic colours, and bearing banners; at a signal, the lime-light was replaced by yellow light, produced by ninety Bunsen's burners, when every trace of colour disappeared, and the entire phalanx became a ghastly company of spectres bearing banners of white and black. This experiment brought this highly-interesting and instructive lecture to a close.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Comptes Rendus.

April 13, 1868.

H. Debray, "On the Formula of Molybdic Acid, and on the Equivalent of Molybdenum." L. Troost and P. Hautefeuille, "On the Production of Paracyanogen, and on its Transformation into Cyanogen." H. Caron, "On the Use of Fluoride of Calcium in Smelting Iron Ores containing Phosphorus." P. Schutzenberger, "On the Crystallisation of Sulphur. On some Chemical Reactions which give rise to the Formation of Oxychloride of Carbon." Chevrier, "On the Amides of Sulphoxyphosphoric Acid."

April 20, 1868.

A. Wurtz, "On the Identity of Artificial Neurine with that obtained from the Brain." L. Troost and P. Hautefeuille, "On the Production of Paracyanogen, and on its Transformation into Cyanogen." Jeannel, "On the Preparation of the Salts of Sesquioxide of Iron and on Oxychloride of Iron." F. Jean, "Note on the Manufacture of Phosphate of Soda and of Fluoride of Sodium." P. Schutzenberger, "On a New Acetate of Chromium." C. Friedel and A. Ladenburg, "On some Derivatives of the Radical Silico-Allyl.

April 27, 1868.

Savary, "On a Sulphur, Carbon, and Salt Water Battery." F. P. Le Roux, "On the Introduction of a Cylinder of Magnesia into the Voltaic Arc for the purpose of increasing and steadying the Light produced." H. Caron, "On the Preparation of Magnesia to be used for the Manufacture of Refractory Articles."

Annales des Mines.

No. 5. 1867.

N. Kokscharow, "On the Decolouration of the Topaz." Goppert, "On some Minerals which may be found associated with the Diamond." Czech, "On a Specimen of Crystallised Graphite." Naumann, "On the Pyro-Electricity of Quartz." Streng, "On the Composition of certain Silicates." Fuchs, "On the Specific Gravity of certain Silicates." Guthe, "On the Composition of Garnet." J. A. Michaelson, "On the Composition of Hornblende. Hermann, "On Wöhlerite, Æschynite, and Euxenite." Haidinger, "Analysis of Meteoric Iron from Dakotah, India." Borichy, "Analysis of Meteoric Iron from Carthage, North America." Reichardt, "On Kainite from Stassfurt, Prussia." Breithaupt, "On the Presence of Magnesia in Arragonite."

Annales de Chimie et de Physique.

March, 1868.

J. L. Soret, "Researches on the Density of Ozone." J. B. Boussingault, "On the Functions of Leaves."

Archives des Sciences.

April 15, 1868.

H. Wild, "On the Absorption of Light by Dry and Moist Air."

Bulletin de la Société Chimique de Paris.

March, 1868.

Berthelot, "A General Method of Reducing and Saturating Organic Compounds with Hydrogen." Lecoq de Boisbaudran, "On the Supersaturation of Saline Solutions."

Dingler's *Polytechnisches Journal.*

April, 1868.

P. von Tunner, "On Oudry's Method of Depositing Copper on Iron by Voltaic Electricity." Reichert, "On the Manufacture of Magnesium from Carnallite." C. Nollner, "On a Compound of Bichloride of Tin and Chloride of Sodium. On an Explosion of Hydrogen in a Vacuum Pan at the Kuttenberg Sugar Refinery."

Journal fur Praktische Chemie.

March, 1868.

H. Ritthausen, "On Vegetable Casein or Legumin. On the Products of the Decomposition of the Legumin and the Protein Compounds of the Lupine and Almond by Boiling with Sulphuric Acid. On Glutanic Acid, a Product of the Decomposition of Glutamic Acid by Nitrous Acid."

Kunst- und Gewerbeblatt.

March, 1868.

M. Zangerle, "On the Use of Petroleum as Fuel." W. A. Herb, "On the Manufacture of Artificial Precious Stones." J. B. Schober, "Analysis of Polyhalite from Berchtesgaden, Bavaria."

May 4, 1868.

Boulay, "Note on a New Constant Battery." L. Cailletet, "On the Permeability of Iron to Hydrogen at Ordinary Temperatures." H. Caron, "On the Preparation of Magnesia for use with the Oxyhydrogen Light." Callaud, "On some Experiments at Sea with the Author's Two-fluid Voltaic Battery."

Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften zu Wien (Mathematisch-Naturwissenschaftliche Classe.)

October, 1867.

J. Wolff, "A Chemical Examination of the Iron Ores of Huttenberg, Carinthia." F. von Uchatius, "Some Improvements in the Author's Method of Testing Powder." A. Grabowski, "On the Tannin of Oak Bark." G. Malin, "On Isodulcitic Acid. Contributions to the Knowledge of Camphor." H. Hlasiwetz and A. Grabowski, "On the Decomposition of Camphoric Acid by Caustic Alkalies." M. Reiner, "An Analysis of the Mineral Spring at Sauerbrunn, Wiener-Neustadt." A. Vierthaler, "An Analysis of the Sulphurous Spring at Spalato. An Analysis of Water from the River Cettina, Dalmatia. On the Variations in the Composition of the Sea Water off Spalato." J. Oser, "Researches on Alcoholic Fermentation."

NOTES AND QUERIES.

Potato Powder.—Will any of your correspondents kindly tell me how to reduce potatoes to powder? All my attempts at drying them convert them to a tough, discoloured, leather-like mass.—A Constant Subscriber.

Colour of Oil.—The suggestion of "Oil Refiner" is plausible enough, but without samples of oils of guaranteed purity, and as fresh as desirable to the trade, it would be rather guess and hap-hazard work to make, or try to make, what "Oil Refiner" desires; in a perfectly pure state, all the fixed oils are either only slightly yellowish-coloured, or even perfectly colourless—as, for instance, cold drawn castor oil—or exhibit a peculiar tinge, *sui generis*, belonging to the genuine oil itself, hempseed oil, *e.g.*, being of a greenish hue. Much of the colour of the fixed oils is due to, and derived from, the integuments of the seeds from which they are obtained, or depends, as is the case with raw cotton-seed oil, upon the presence within the seed of small cells filled with an oleo-resinous-coloured matter, which gets dissolved in the raw oil, in consequence of the breaking of the cells, when pressure is applied to the seed to obtain the oil.

Printing Ink.—The great bulk of printing ink consists of what, in chemical parlance, is anhydride of linoleic acid ($C_{32}H_{27}O_3$); this material presents, in many of its properties, a great similarity to caoutchouc, like which it may be regarded as a product of oxidation. I have instituted a few experiments to wash both old printing ink, and more recent, out of paper, and find that chloroform answers this purpose best; benzol, coal-tar oil, and the light petroleum oil have no effect whatever; sulphide of carbon does not act very satisfactorily, and I cannot also speak very favourably of oil of turpentine. Next to chloroform, I find that caustic soda answers best; but it at once also disintegrates the paper, converting it into pulp, while evidently the anhydride of linoleic acid, in other terms the boiled linseed oil, is completely dissolved and removed from the paper. The very minutely-divided lampblack, carbonaceous matter, added to the boiled oil, becomes dispersed through the paper pulp, giving it a greyish tinge; by bleaching agents, however, this tinge gets changed to white. If "Paper Maker" desires more information on the subject—how best to use chloroform in a manner consistent with the expense, volatility, and other difficulties which are in the way—I shall be happy to convey to him such information; but, as it would be taking too much space to do so in these columns, I therefore suggest, if so inclined, that "Paper Maker" should send his name and address to the Office of the Chemical News.—Dr. A. A.

TO CORRESPONDENTS.

E. Oldreive.—1. Fresenius's "Qualitative Analysis"; to be followed up by a study of his "Quantitative Analysis." 2. Liebig's "Agricultural Chemistry."

J. H. S.—The subject is not of sufficient importance to be worth devoting more space to it. See Mr. Readwin's letter in this number. The most reasonable supposition is that we do not know what was the experiment which the deceased was trying; the evidence before the coroner was not clear on this point.

E. C.—Consult any elementary book on chemistry. We cannot tell the price, until we know in what form it is required.

W. B.—Please repeat the question, spelling the words in full and writing a little plainer.

Alpha.—The book shall be sent.

Communications have been received from S. Ivanoff; Messrs. Townsend and Adams; Dr. T. L. Phipson (with enclosure); E. Oldreive; J. Bowing (with enclosure); H. Bagshaw; W. Little; W. Toulman (with enclosure); E. Schunck (with enclosure); Alment and Johnson; C. Mitchell and Co.; R. J. Williams; Nicholson, Taylor, and Co.; E. W. Ball; Dr. S. Muspratt (with enclosure); M. A. Gage (with enclosure); J. Carteighe; J. Napier (with enclosure); Dr. Divers (with enclosure); B. T. Simmons; and C. R. C. Tichborne.

BOOKS RECEIVED.

On Aniline and its Derivatives. By M. Riemann, P.D., L.A.M. To which is added, in an appendix, The Report on the Colouring Matters derived from Coal Tar, shown at the French Exhibition, 1867. By Dr. A. W. Hofmann, F.R.S.; MM. G. de Laire and Ch. Girard. The whole revised and edited by William Crookes, F.R.S., &c. London: Longmans.

Water Analysis: a practical treatise on the Examination of Potable Waters. By J. A. Wanklyn and E. T. Chapman. London: Trübner.

Essay on the Comparative Efficiency of Spectroscope Prisms of Different Angles. By Edward C. Pickering.

THE CHEMICAL NEWS.

Vol. XVIII. No. 450.

ON THE MEASUREMENT OF
THE LUMINOUS INTENSITY OF LIGHT.

By WILLIAM CROOKES, F.R.S., &c.

The measurement of the intensity of a ray of light is a problem the solution of which has been repeatedly attempted, but with less satisfactory results than the endeavours to measure the other radiant forces. The problem is susceptible of two divisions—the absolute and the relative measurement of light.

I. Given a luminous beam, we may require to express its intensity by some absolute term having reference to a standard obtained at some previous time, and capable of being reproduced with accuracy at any time in any part of the globe. Possibly two such standards would be necessary, differing greatly in value, so that the space between them might be subdivided into a definite number of equal parts; or the same result might perhaps be obtained by the well-known device of varying the apparent intensity of the standard light by increasing and diminishing its distance from the instrument.

II. The standard of comparison, instead of being obtained once for all, like the zero- and boiling-points of a thermometer, may be compared separately at each observation; and the problem then becomes somewhat simplified into the determination of the relative intensities of two sources of light.

The *absolute* method is of course the most desirable; but as the preliminary researches and discoveries are yet to be made, before a photometer, analogous to a thermometer in fixity of standard and facility of observation, could be devised, the realisation of an absolute light-measuring method appears somewhat distant. The path to be pursued towards the attainment of this desirable object appears to be indicated in the observations which from time to time have been made by Becquerel, Herschel, Hunt, and others, on the chemical action of the solar rays, and the production thereby of a galvanic current, capable of measurement on a delicate galvanometer, by appropriate arrangements of metallic plates and chemical baths connected with the ends of the galvanometer wires.

Many so-called photometers have been devised, by which the chemical action of the rays at the most refrangible end of the spectrum have been measured, and the chemical intensity of light tabulated by appropriate methods; and within the last few years Professors Bunsen and Roscoe have contrived a perfect chemical photometer, based upon the action of the chemical rays of light on a gaseous mixture of chlorine and hydrogen, causing them to combine with formation of hydrochloric acid.

But the measurement of the chemical action of a beam of light is as distinct from photometry proper, as is the thermometric registration of the heat rays constituting the other end of the spectrum. What we want is a method of measuring the intensity of those rays which are situated at the intermediate parts of the spectrum, and produce in the eye the sensation of light and colour; and, as previously suggested, there is a reasonable presumption that further researches may place us in possession of a photometric method based upon the chemical action of the *luminous* rays of light.

The rays which effect an ordinary photographic sensitive surface, are so constantly spoken of and thought about as the ultra-violet invisible rays, that it is apt to be forgotten that some of the highly luminous rays of light are capable of exerting chemical action. Fifteen years ago* the writer was engaged in some investigations on the chemical action of light, and he succeeded in producing all the ordinary phenomena of photography, even to the production of good photographs in the camera, by purely luminous rays of light, free from any admixture with the violet and invisible rays. When the solar spectrum, of sufficient purity to show the principal fixed lines, is projected for a few seconds on to a sensitive film of iodide of silver, and the latent image then developed, the action is seen to extend from about the fixed line G to a considerable distance into the ultra-violet invisible rays. When the same experiment was repeated with a sensitive surface of bromide of silver instead of iodide of silver, the result of the development of the latent image showed that in this case the action commenced at about the fixed line *b*, and extended, as in the case of the iodide of silver, far beyond the violet. A transparent cell, with parallel glass sides one inch across, was filled with a solution of twenty-five parts of sulphate of quinine to one hundred parts of dilute sulphuric acid; this was placed across the path of the rays of light, and photographs of the spectrum were again taken on iodide of silver and on bromide of silver, the arrangements in all cases being identical with those in the first cited experiments, with the exception of the interposition of the quinine screen. The action of the sulphate of quinine upon a ray of light is peculiar; to the eye it scarcely appears to have any action at all, but it is absolutely opaque to the ultra-violet, so-called chemical rays, and thus limits the photographic action on the bromide and iodide of silver to the purely luminous rays. On developing the latent images, it was now found that the action on iodide of silver was confined to a very narrow line of rays, close to the fixed line G, and in the case of bromide of silver to the space between *b* and G. Designating the spaces of action by colours instead of fixed lines, it was thus proved that, behind a screen of sulphate of quinine, iodide of silver was affected only by the luminous rays about the centre of the indigo portion of the spectrum, whilst bromide of silver was affected by the green, blue, and some of the indigo rays.

It is very likely that a continuance of these experiments would lead to the construction of a photometer capable of measuring the luminous rays; for although bromide of silver behind quinine is not affected by the red or yellow rays, still it is by the green and blue; and as the proportion of red, yellow, green, and blue rays is always invariable in white light (or the light would not be white but coloured), a method of measuring the intensity of one set of the components of white light would give all the information we want; just as, in an analysis of a definite chemical compound, the chemist is satisfied with an estimation of one or two constituents only, and calculates the others.

Method based upon the foregoing considerations would supply us with what may be termed an *absolute* photometer, the indication of which would be always the same for the same amount of illumination, requiring no standard light for comparison; and pending the development of experiments which the writer is prosecuting in this direction, he has been led to devise a new and, as he believes, a valuable form of *relative* photometer.

A relative photometer is one in which the observer has only to determine the relative illuminating powers of two sources of light, one of which is kept as uniform as possible, the other being the light whose intensity is to be determined. It is therefore evident that the great thing to be aimed at is an absolutely uniform source of light. In the ordinary process of photometry the standard used is a candle, defined by Act of Parliament as a "sperm candle of six to the pound, burning at the rate of 120 grains per hour. This is the standard from which estimates of the value of illuminating gas are deduced, hence the terms "12-candle gas," "14-candle gas," &c. In his work on *Gas Manipulation*, Mr. Sugg gives a very good account of the difficulties which stand in the way of obtaining uniform results with the Act of Parliament candle. A true sperm candle is made from a mixture of refined sperm with a small proportion of wax, to give it a certain toughness, the pure sperm itself being extremely brittle. The wick is of the best cotton, made up into three cords and plaited. The number of strands in each of the three cords composing the wick of a six-to-the-pound candle is seventeen, although Mr. Sugg says there does not appear to be any fixed rule, some candles having more and others less, according to the quality of the sperm. Sperm candles are made to burn at the rate of one inch per hour, and the cup should be clean, smooth, and dry. The wick should be curved slightly at the top, the red tip just showing through the flame, and consuming away without requiring snuffing. To obtain these results, the tightness of the plaiting and size of the wick require careful attention; and as the quality of the sperm differs in richness or hardness, so must the plaiting and number of strands. A variety of modifying circumstances thus tend to affect the illuminating power of a standard sperm candle. These difficulties, however, are small, compared with those which have resulted from the substitution of paraffin, &c., for part of the sperm; and Mr. Sugg points out that candles can be made with such combinations of stearin, wax, or sperm, and paraffin, as to possess all the characteristics of sperm candles, and yet be superior to them in illuminating power; while, on the other hand, candles made from the same materials otherwise combined are inferior. When, in addition to this, it is found that candles containing paraffin require wicks more tightly plaited and with fewer strands than those suitable for the true sperm candle, our readers will be enabled to judge of the almost unsurmountable difficulties which beset the present system of photometry.

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* *The Journal of the Photographic Society*, vol. i.

But assuming that the true parliamentary sperm candle is obtained, made from the proper materials and burning at the specified rate, its illumininating power will be found to vary with the temperature of the place where it has been kept, the time which has elapsed since it was made, and the temperature of the room wherein the experiment is tried.

The Rev. W. R. Bowditch, in his work on *The Analysis, Purification, &c., of Coal Gas,* enters at some length into the question of test-candles, and emphatically condemns them as light-measures; one experiment quoted by this author showed that the same gas was reported to be 14·63 or 17·36 candle gas, according to the way the experiment was conducted.

The present writer has taken some pains to devise a source of light which should be at the same time fairly uniform in its results, would not vary by keeping, and would be capable of accurate imitation at any time and in any part of the world by mere description. The absence of these conditions seems to be one of the greatest objections to the sperm candle. It would be impossible for an observer on the continent, ten or twenty years hence, from a written description of the sperm candle now employed, to make a standard which would bring his photometric results into relation with those obtained here. Without presuming to say positively that he has satisfactorily solved all difficulties, the writer believes that he has advanced some distance in the right direction, and pointed out the road for further improvement.

Before deciding upon a standard light, experiments were made to ascertain whether the electric current could be made available. Through a coil of platinum wire, so as to render it brightly incandescent, a powerful galvanic current was passed; and its strength was kept as constant as possible by a thick wire galvanometer and rheostat. To prevent the cooling action of air-currents, the incandescent coil was surrounded with glass; and it was hoped that by employing the same kind of battery and by varying the resistance so as to keep the galvanometer needle at the same deflection, uniform results could be obtained. In practice, however, it was found that many things interfered with the uniformity of the results, and the light being much feebler than it was advisable to work with, this plan was deemed not sufficiently promising, and it was abandoned. The method ultimately decided upon is the following;—Alcohol of sp. gr. 0·805, and pure benzol boiling at 81° C., are mixed together in the proportion of 5 volumes of the former and 1 of the latter. This burning fluid can be accurately imitated from description at any future time and in any country, and if a lamp could be devised equally simple and invariable, the light which it would yield would, it is presumed, be invariable. This difficulty, the writer has attempted to overcome in the following manner.

A glass lamp is taken of about 2 ounces capacity, the aperture in the neck being 0·25 inch diameter; another aperture at the side allows the liquid fuel to be introduced, and by a well-known laboratory device, the level of the fluid in the lamp can be kept uniform. The wick-holder consists of a platinum tube 1·81 inches long and 0·125 inch internal diameter. The bottom of this is closed with a flat plug of platinum, apertures being left in the sides to allow free access of spirit. A small platinum cup ·5 inch diameter and ·1 inch deep is soldered round the outside of the tube 0·5 inch from the top, answering the threefold purpose of keeping the wick-holder at a proper height in the lamp, preventing evaporation of the liquid, and keeping out dust. The wick consists of 52 pieces of hard-drawn platinum wire, each 0·01 inch in diameter and 2 inches long, perfectly straight and tightly pushed down into the platinum holder until only 0·1 inch projects above the tube. The height of the burning fluid in the lamp must be sufficient to cover the bottom of the wick holder: it answers best to keep it always at the uniform distance of 1·75 inches from the top of the platinum wick; a slight variation of level, however, has not been found to influence the light to an extent appreciable by our present means of photometry. The lamp having the reservoir of spirit thus arranged, the platinum wires parallel and their projecting ends level, a light is applied, and the flame instantly appears, forming a perfectly-shaped cone 1·25 inches in height, the point of maximum brilliancy being 0·56 inch from the top of the wick. The extremity of the flame is perfectly sharp, without any tendency to smoke; without flicker or movement of any kind, it burns, when protected from currents of air, at a uniform rate of 136 grains of liquid per hour. The temperature should be about 60° F., although moderate variations on either side exert no preceptible influence. Bearing in mind Dr. Frankland's observations on the direct increase in the light of a candle with the atmospheric pressure, accurate observations ought only to be taken at one height of the barometer. To avoid the inconvenience and delay which this would occasion, a table of corrections should be constructed for each 0·1 inch variation of barometric pressure.

There is no doubt that this flame is very much more uniform than that of the sperm candle sold for photometric purposes. Tested against a candle, considerable variations in relative illuminating power have been observed; but on placing two of these lamps in opposition, no such variations have been detected. The same candle has been used, and the experiments have been repeated at wide intervals, using all usual precautions to ensure uniformity. The results are thus shown to be due to variations in the candle and not in the lamp.

It is expected that whoever may be inclined to adopt the kind of lamp here suggested will find not only that its uniformity may be relied upon, but that, by following accurately the description and dimensions here laid down, each observer will possess a lamp of equivalent and convertible photometric value, so that results may not only be strictly comparable between themselves, but, within slight limits of accuracy comparable with those obtained by other experimentalists. The dimensions of wick, &c., here laid down are not intended to fix the standard. Persons engaged in photometry as an important branch of their regular occupation will be better able to fix these data than the writer, by whom photometry is only oc-

occasionally pursued as a means of scientific research. Already many improvements suggest themselves, and several causes of variation in the light have been noticed. Future experiments may point out how these sources of error are to be overcome; but at present there is no necessity to refine our source of standard light to a greater degree of accuracy than the photometric instrument admits of.

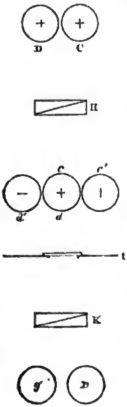
The instrument for measuring the relative intensities of the standard and other lights, next demands attention. The contrivances in ordinary use are well known. Most of them depend on a well-known law in optics, namely, that the amount of light which falls upon a given surface varies inversely as the square of the distance between the source of light and the object illuminated. The simplest observation which can be taken is made by placing two sources of light (say a candle and gas-lamp) opposite a white screen a few feet off, and placing a stick in front of them, so that two shadows of the stick may fall on the screen. The strongest light will cast the strongest shadow; and by moving this light away from the stick, keeping the shadows side by side, a position will at last be found at which the two shadows appear of equal strength. By measuring the distance of each light from the screen, and squaring it, the product will give the relative intensities of the two sources of light.

In practice, this plan is not sufficiently accurate to be used except for the roughest approximations; and from time to time several ingenious contrivances, all founded upon the same law, have been introduced by scientific men, by which a much greater accuracy is obtained: thus in Ritchie's photometer the lights are reflected on to a piece of oiled paper in a box, and their distances are varied until the two halves of the paper are equally illuminated. In Bunsen's photometer, which is the one now generally used, the lights shine on opposite sides of a disc of white paper, part of which has been smeared with melted spermaceti to make it more transparent. When illuminated by a front light the greased portion of the paper will look dark; but if the observer goes to the other side of the paper, the greased part looks the lighter. If, therefore, lights of unequal intensity are placed on opposites sides of a piece of paper so prepared, a difference will be observed; but by moving one backwards or forwards, so as to equalise the intensity, the whole surface of the paper will appear uniformly illuminated on both sides. This photometer has been modified by many observers. By some the disc of paper is moved, the lights remaining stationary; by others the whole is enclosed in a box, and various contrivances are adopted to increase the sensitiveness of the eye and to facilitate calculation: but in all these the sensitiveness is not greatly augmented, as the eye cannot judge of very minute differences of illumination approximating to equality.

In 1833, Arago described a photometer in which the phenomena of polarised light were employed. This instrument is fully described, with drawings, in the tenth volume of the *Œuvres Complètes de François Arago*; but the description, although voluminous, is far from clear. The principle of its construction is founded on "the law of the square of the cosines," according to which polarised rays pass from the ordinary to the extraordinary image. The knowledge of this law, he says, will not only prove theoretically important, but will further lead to the solution of a great number of very important astronomical questions. Suppose, for example, that it is wished to compare the luminous intensity of that portion of the moon directly illuminated by the solar rays with that of the part which receives only light reflected from the earth, called the *partie cendrée*. Were the law in question known, the way to proceed would be as follows:—After having polarised the moon's light, pass it through a doubly refracting crystal, so disposed that the rays, not being able to bifurcate, may entirely undergo ordinary refraction. A lens placed behind this crystal will therefore show but one image of our satellite; but as the crystal in rotating on its axis passes from its original position, the second image will appear, and its intensity will go on augmenting. The movement of the crystal must be arrested at the moment when, in this growing extraordinary image, the segment corresponding to the part of the moon illuminated by the sun, exhibits the intensity of the ashy part shown by the ordinary image. From these data it is easy to perceive, he says, that the problem is capable of solution.

In another part of the same volume, after speaking of the polariscope which goes by his name, Arago writes:—"I have now arrived at the general principle upon which my photometric method is entirely founded. The quantity (I do not say the proportion)—the quantity o completely polarised light, which forms part of a beam partially polarised by reflection, and the quantity of light polarised rectangularly which is contained in the beam transmitted under the same angle, are exactly equal to each other. The reflected beam and the beam transmitted under the same angle by a sheet of parallel glass, have in general very dissimilar intensities; if, however, we examine with a doubly refracting crystal, first the reflected and then the transmitted beam, the greatest difference of intensity between the ordinary and the extraordinary images will be the same in the two cases, because this difference is precisely equal to the quantity of polarised light which is mixed with the common light."

Fig. 1.



In Arago's astronomy, the author again describes his photometer in the following words: "I have constructed an apparatus by means of which, upon operating with the polarised image of a star, we can succeed in attenuating its intensity by degrees exactly calculable after a law which I have demonstrated." It is difficult to obtain an exact idea of this instrument from the description given; but from the drawings it would appear to be exceedingly complicated, and to be different in principle and construction from the one now about to be described. The present photometer has this in common with that of Arago, as well as with those described in 1853 by Bernard,* and in 1854 by Babinet,† that the phenomena of polarised light are used for effecting the desired end. But it is believed that the present arrangement is quite new, and it certainly appears to answer the purpose in a way which leaves little to be desired. The instrument will be better understood if the principles on which it is based are first described.

Fig 1 shows a plan of the arrangement of parts, not drawn to scale, and only to be regarded as an outline sketch to assist in the comprehension of general principles. Let D represent a source of light. This may be a white disc of porcelain or paper illuminated by any artificial or natural light. C represents a similar white disc likewise illuminated. It is required to compare the photometric intensities of D and C. (It is necessary that neither D nor C should contain any polarised light, but that the light coming from them, represented on each disc by the two lines at right angles to each other, forming a cross, should be entirely unpolarised). Let H represent a double refracting achromatic prism of Iceland spar; this will resolve the disc D into two discs, *d* and *d'*, polarised in opposite directions; the plane of *d* being, we will assume, vertical, and that of *d'* horizontal. The prism H will likewise give two images of the disc C; the image *c* being polarised horizontally, and *c'* vertically. The size of the discs D, C, and the separating power of the prism H are to be so arranged that the vertically polarised image *d*, and the horizontally polarised image *c*, exactly overlap each other, forming, as shown in the figure, one compound disc *c d*, built up of half the light from D and half that from C.

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* *Comptes Rendus.* April 25, 1853.

† *Proceedings of the British Association*, Liverpool Meeting, 1854.

The measure of the amount of free polarisation present in the disc *c d*, will give the relative photometric intensities of D and C.

The letter I represents a diaphragm with a circular hole in the centre, just large enough to allow the compound disc *c d* to be seen, but cutting off from view the side discs *c' d'*. In front of the aperture in I is placed a piece of selenite of appropriate thickness for it to give a strongly-contrasting red and green image under the influence of polarised light. K is a doubly refracting prism, similar in all respects to H, placed at such a distance from the aperture in I that the two discs into which I appears to be split up are separated from each other, as at *g r*. If the disc *c d* contains no polarised light, the images *g r* will be white, consisting of oppositely polarised rays of white light; but if there is a trace of polarised light in *c d*, the two discs *g r* will be coloured complimentarily; the contrast between the green and red being stronger in proportion to the quantity of polarised light in *c d*.

FIG. 2.

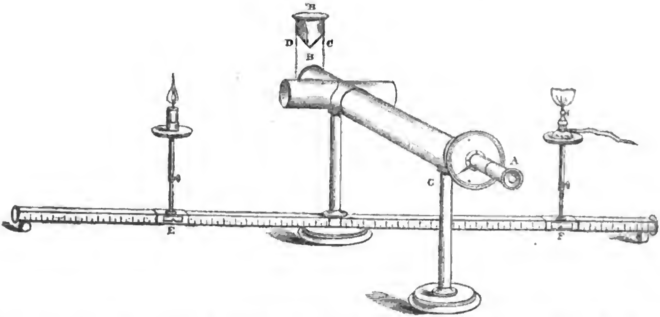
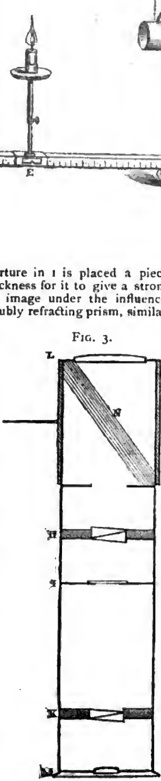


FIG. 3.



The action of this arrangement will be readily evident. Let it be supposed in the first place that the two sources of light, D and C, are exactly equal. They will each be divided by H into two discs, *d' d* and *c c'*, and the two polarised rays of which *c d* is compounded will also be absolutely equal in intensity, and will neutralise each other and form common light, no trace of free polarisation being present. In this case the two discs of light, *g r*, wil be colourless. Let it now be supposed that one source o light (D for instance) is stronger than the other (C). It follows that the two images *d' d* will be more luminous than the two images *c c'*, and that the vertically polarised ray *d* will be stronger than the horizontally polarised ray *c*. The compound disc *c d* will therefore shine with partially polarised light, the amount of free polarisation being in exact ratio with the photometric intensity of D over C. In this case the image of the selenite plate in front of the aperture I will be divided by K into a red and a green disc.

Fig. 2. shows the instrument fitted up. A is the eyepiece (shown in enlarged section at Fig. 3). G B is a brass tube, blacked inside, having a piece, shown separate at D C, slipping into the end B. The sloping sides, D B, B C, are covered with a white reflecting surface (white paper or finely-ground porcelain), so that when D C is pushed into the end B, one white surface, D B, may be illuminated (as in Fig. 2) by the candle, and the other surface, B C, by the lamp. If the eye-piece A is removed, the observer, looking down the tube G B, will see at the end a luminous white disc divided vertically into two parts, one half being illuminated by the candle E, and the other half by the lamp F. By moving the candle E, for instance, along the scale, the illumination of the half D B can be varied at will, the illumination of the other half remaining stationary.

The eye-piece A (shown enlarged at Fig. 3) will be understood by reference to Fig. 1, the same letters representing similar parts. At L is a lens to collect the rays from D B C (Fig. 2), and throw the image into the proper part of the tube. At M is another lens, so adjusted as to give a sharp image of the two discs into which I is divided by the prism K. The part N is an adaptation of Arago's polarimeter; it consists of a series of thin plates of glass capable of moving round the axis of the tube, and furnished with a pointer and graduated arc (shown at A, O, Fig. 2). By means of this pile it is possible to partially polarise the rays coming from the illuminated discs in one or the other direction, and thus bring to the neutral state the partially polarised beam *c d* (Fig. 1), so as to get the images *g r* free from colour. It is so adjusted that when at the zero point it produces an equal effect on both discs.

The action of the instrument is as follows. The standard lamp being placed on one of the supporting pillars which slide along the graduated stem (Fig. 2), it is adjusted to the proper height, and moved along the bar to a convenient distance, depending on the intensity of the light to be measured; the whole length being a little over four feet, each light can be placed at a distance of twenty-four inches from the disc. The flame is then sheltered from currents of air by black screens placed round, and the light to be compared is fixed in a similar way on the other side of the instrument. The whole should be placed in a dark room, or surrounded with non-reflecting screens; and the eye must also be protected from direct rays from the two lights. On looking through the eye-piece two bright discs will be seen, probably of different colours. Supposing E represents the standard flame, and F the light to be compared with it, the latter must now be slid along the scale until the two discs of light, seen through the eye-piece, are about equal in tint. Equality of illumination is easily obtained; for, as the eye is observing two adjacent discs of light, which pass rapidly from *red-green* to *green-red*, through a neutral point of no colour, there is no difficulty in hitting this point with great precision. It has been found most convenient not to attempt to get absolute equality in this manner, but to move the flame to the nearest inch on one side or the other of equality. The final adjustment is now effected at the eye-end, by turning the polarimeter one way or the other up to 45°, until the images are seen without any trace of colour. This will be found more accurate than the plan of relying entirely on the alteration of the distance of the flame along the scale; and by a series of experimental adjustments, the value of every angle through which the bundle of plates is rotated can be ascertained once for all, when the future calculations will present no difficulty. Squaring the number of inches between the flames and the centre will give their approximate ratios; and the number of degrees the eye-piece rotates will give the number to be added or subtracted in order to obtain the necessary accuracy.

The delicacy of the instrument is very great. With two lamps, each about twenty-four inches from the centre, it is easy to distinguish a movement of one of them to the extent of 1-10th of an inch to or fro; and by using the polarimeter, an accuracy considerably exceeding that can be attained.

The employment of a photometer of this kind enables us to compare lights of different colours with one another, and leads to the solution of a problem which, from the nature of their construction, would be beyond the powers of the instruments in general use. So long as the observer, by the eye alone, has to compare the relative intensities of two surfaces respectively illuminated by the lights under trial, it is evident that unless they are of the same tint it is impossible to obtain that absolute equality of illumination in the instrument which is requisite for a comparison. By the unaided eye one cannot tell which is the brighter half of a paper disc illuminated on one side with a reddish, and on the other with a yellowish light; but by using the above-described photometer, the problem becomes practicable. For instance, on reference to Fig. 1, suppose the disc D were illuminated with light of a reddish colour, and the disc C with greenish light, the polarised discs *d' d* would be reddish, and the discs *c c'* greenish, the central disc *c d* being of the tint formed by the union of the two shades. The analysing prism K, and the selenite disc I will detect free polarisation in the disc *c d*, if it be coloured, as readily as if it were white; the only difference being that the two discs of light *g r* cannot be brought to a uniform *white* colour when the lights from D and C are equal in intensity, but will assume a tint similar to that of *c d*. When the contrasts of colour between D and C are very strong—when, for instance, one is a bright green and the other scarlet—there is some difficulty in estimating the exact point of neutrality; but this only diminishes the accuracy of the comparison, and does not render it impossible, as it would be according to other systems.

No attempt has been made in these experiments to ascertain the exact value of the standard spirit-flame in terms of the parliamentary sperm candle. Difficulty was experienced in getting two lots of candles yielding light of equal intensities, and when their flames were compared between themselves and with the spirit-flame, variations of as much as 10 per cent were sometimes observed in the light they gave. Two standard spirit-flames, on the other hand, seldom showed a variation of 1 per cent, and had they been more carefully made they would not have varied 0·1 per cent.

This plan of photometry is capable of far more accuracy than the present instrument will give. It can scarcely be expected that the first instrument of the kind, roughly made by an amateur workman, should possess equal sensitiveness with one in which all the parts have been skilfully made with special adaptation to the end in view.—*Quarterly Journal of Science.*

ON A CONVENIENT FORM OF ASPIRATOR.

By Professor ALBERT R. LEEDS, of Haverford College, Pa.

A PAIL containing water is placed at the edge of the table and to the stop-cock which is attached to the side of the pail near the bottom, a tube of two or three feet in length is connected, to carry off the water to a bucket placed on the floor below. When the bucket is filled, the stop-cock is turned off for a moment, and the water poured back into the pail. To the top of the stop-cock tube, which should be made straight and somewhat longer than usual, and in front of the stop-cock itself, a short vertical tube is attached and connected by means of india-rubber tubing with the wash-bottle or other vessel through which gas is to be drawn. On partially opening the stop-cock, the deficiency of water is made up by a large quantity of air or gas, which is drawn in through the vertical tube above mentioned.—*Am. Journ. Sci.*, May, 1868.

ANALYSIS OF PYRITES' RESIDUE.

By Dr. T. L. PHIPSON, F.C.S., &c., London.

The following analysis represents the residue of pyrites obtained in the Drumburgh Chemical Works, Cumberland, where Norwegian pyrites is principally burnt:—

Oxide of zinc	5·50
„ copper	2·86
„ manganese	1·60
„ nickel and cobalt	0·12
„ cadmium	0·01
„ lead	1·67
„ antimony	0·04
Protoxide of iron	1·17
Alumina	3·25
Arsenic	none
Sulphur	2·60
Thallium and indium	trace
Rock	15·00
Peroxide of iron (by difference) direct 67·00	65·99
Lime	0·11
Magnesia	0·08
	100·00

The figures representing zinc, copper, and sulphur are the mean results of several analyses; the other substances were only once determined. The rock, or gangue, consists in this case entirely of quartz and mica schist; it is, therefore, principally silica. The sulphur is mostly free, and often visible. In the deposit formed in the tunnel itself only a trace of arsenic was found. The red flue dust differs considerably from this residue in its composition; and this again differs from the deposit in the tunnel—especially when the latter gets too hot—and from that in No. 1 chamber adjoining.

FOREIGN SCIENCE.

PARIS, JULY 15, 1868.

Cerium.—Fluorescent liquid.—Examination of the light in certain cases of phosphorescence.—Death of M. Pouillet.—ACADEMY OF SCIENCES: Electro-capillary phenomena, separating media and the influence of colouring matter.—Dilation of solid bodies by heat.—Two isomeric phenols.

M. Wohler has published the following facts concerning the metal cerium. The metal itself was obtained by the following process:—A solution of the brown oxide of cerium in hydrochloric acid was mixed with an equivalent quantity of chloride of potassium and of chloride of ammonium, and the whole evaporated to dryness. The mass was then transferred to a platinum crucible, and heated till the whole of the chloride of ammonium was volatilised and fusion obtained. The fused mass was poured out, coarsely powdered, and mixed while still warm with fragments of sodium, and introduced into an earthen crucible previously heated to redness. When the contents had again fused and the excess of sodium volatilised, the crucible was removed from the fire; the deep grey resulting mass was filled with little metallic globules. In a second experiment a large piece of sodium was thrown into a red-hot crucible containing chloride of potassium, and then the coarsely powdered chloride used before. In operating in this way, a larger proportion of metallic globules was obtained, some of which weighed 50 to 60 milligrammes. These metallic globules appear to consist principally of cerium. The colour of the metal is intermediate between the colour of iron and that of lead. The metal is lustrous when polished; it is malleable. Its density is about 5·5 at 12°. Exposed to the air it loses its lustre, and becomes slightly blue. It feebly decomposes water at 100°. Hydrochloric acid dissolves it with energy; concentrated nitric acid converts it into clear brown oxide, the dilute acid dissolves it. By evaporation, a white salt is obtained which leaves, after calcination, a brown oxide, insoluble in nitric acid and in dilute sulphuric acid. Concentrated sulphuric acid slowly dissolves this oxide, forming a yellow solution which shows the reactions of ceric salts. Hydrochloric acid dissolves this oxide with disengagement of chlorine, forming a colourless solution. When a globule of cerium is heated by the blow-pipe to dull redness, the metal inflames and burns vividly, forming brown oxide; but upon submitting a globule suddenly to a very high temperature, it burns with explosion, sending out bluish sparks. Cerium powder can inflame below 100°

When the saline mass containing the cerium globules is treated with water, a fetid hydrogen gas is liberated, and a brilliant powder of a deep purple colour is deposited, which is easily separated by washing. Dilute hydrochloric acid extracts from this powder a small quantity of metal, as well as of oxide. This body is a cerous oxychloride. Concentrated hydrochloric acid attacks it with difficulty; concentrated nitric acid dissolves it, forming a colourless solution.

A solution which is said to exhibit the most beautiful green fluorescence yet known is yielded by Cuba wood (*Morus tinctoria*). M. Ditte has prepared some alcoholic solutions, possessing remarkable fluorescent properties, with the lake of this dye wood. The process which he has found most advantageous is the following:—The lake is placed in contact with an excess of glacial acetic acid, which dissolves it completely at the end of twenty-four hours. Six times the volume of alcohol is added, and the mass filtered. The liquid thus obtained, viewed by transmitted light, is red, by reflected light, a magnificent green. Upon adding to the acetic acid solution ether quite free from alcohol, a yellow matter is precipitated, and the liquid loses its properties; the precipitate redissolved in alcohol gives again a dichroic liquid. The decoction of the wood is not dichroic, but it becomes so immediately upon the addition of acetate of alumina. The fluorescent liquid, sufficiently diluted to be only slightly coloured, entirely absorbs the most refrangible part of the spectrum, from the blue to the violet. The fluorescence is not visible with the light from a lamp or gas; it is, on the contrary, very vivid with the magnesium light and in Geissler tubes.

M. Kindt has made known the nature of the phosphorescence developed by heat in the three minerals, chlorophane, Estramadura phosphorite, and the green fluor spar. He has analysed the light emitted: the first is a simple green, the second is a yellow tinted light, composed of green, yellow and red, and the third gives two black rays, the one in the green and the other near the orange.

M. Pouillet, the eminent physicist, died on the 14th June, in his 78th year. The following is a brief outline of his career:—In 1829 he became professor of physics at the *Conservatoire des Arts et Metiers*. In 1831, he succeeded Dulong in one of the chairs of physics at *l'Ecole Polytechnique*. On the 17th July, 1837, he entered the Academy of Sciences, in the physicial section, and was made an officer of the Legion of Honour. Among the researches published by him may be cited those on the dilation of elastic fluids and the latent heat of vapours, on the phenomena of interference and diffraction, on solar heat, the radiating and absorbing powers of the atmosphere, and the temperature of space. His memoirs, containing the experimental demonstration of the laws relating to electric currents, are worthy of special mention. It is hardly necessary to connect M. Pouillet's name with his *Traité de physique et de météorologie* and his *Elements de physique*.

The following memoirs brought before the Academy at a recent meeting have not yet been noticed:—Fifth memoir on electro-capillary phenomena; third part, separating media and the influence of colouring matters, by M. Becquerel; on the dilation of solid bodies by heat, by M. Fizeau; note on two isomeric phenols, the xylenols, by M. Wurtz; facts concerning the history of persulphide of hydrogen, by M. Hofmann; note on the existence of starch in the yolk of egg.

M. Becquerel prepared parchment paper with ordinary filter paper by immersing in sulphuric acid containing 15 per cent of water, withdrawing immediately, and washing with a large quantity of water. A tube closed by a diaphragm of this material, and filled with a saturated solution of nitrate of lime, was plunged into a solution equally saturated with sulphate of soda. Stalactites formed on the under surface of the paper, composed of crystallised double sulphate of soda and lime. These stalactites are of variable diameter, varying according to the size of the pores which allow the passage of the nitrate of lime. By diminishing the size of the capillary tubes, the passage of the liquid is indefinitely retarded, until it at length becomes inappreciable. There is a point, in regard to the diameter of these capillary tubes, where the electro-capillary force ceases to act, and where complete filtration ensues; a single pore is sufficient to produce this effect. For this reason it is necessary that the parchment paper be uniform. Some experiments were made with siliceous diaphragms. Columns of sand, varying from 5 millimetres to 5 centimetres in height, kept in position in each case by a tuft of asbestos, were substituted in the former apparatus. In operating in Dutrochet's way, with solution of sugar, solution of salt, and distilled water, simple filtration took place, instead of a strong endosmose with the organic membrane; but this was not the case when a saturated solution of sulphate of soda was placed in the tube, and in the outer vessel another of chloride of barium, an endosmose of 2 centimetres resulting in two days. No precipitate is seen in the outer vessel, so that there is only a displacement of the solution. In placing in a tube closed with a diaphragm of parchment paper a solution of sugar or of salt, coloured with litmus or other colouring matter, and water in the outer vessel, a strong endosmose is produced in the tube, and at the end of a few days traces of colour in the water are only seen with difficulty; the colour is completely arrested by the membrane.

M. Wurtz described some experiments having for their object the transformation of xylene into a xylenol; they have led to the interesting result, that this carbide of hydrogen gives birth to two phenols, isomeric with each other, a solid xylenol and a liquid xylenol. Xylene boiling at 139°, and which had distilled entirely between 138° and 140°, was agitated with double its volume of ordinary sulphuric acid; it dissolved, and to complete its solution a gentle heat was applied by the water-bath. The sulphoxylenic acid thus formed was converted into a barium salt, then into a potassium salt, and the latter fused in a silver crucible with double its weight of potash. The xylenol thus formed was separated by hydrochloric acid and dissolved in ether. The liquid obtained by the evaporation of the ether distilled over at about 210°. Owing to the lowness of the temperature last winter, a mass of crystals took the place of the liquid. These crystals were separated from the mother liquor by compression between blotting paper. After solution in ether, and another evaporation—made by allowing nearly the whole of the ether to evaporate spontaneously, and then depositing the residue upon the blotting paper used before—and finally distilling, pure solid xylenol was obtained. On the other side, the papers impregnated with the crude liquid product were distilled with water. The steam carried over a liquid product nearly insoluble in water. This product, dried and purified by distillation, constitutes the liquid modification of xylenol. *Solid xylenol*, $C_8H_{10}O$.—This body is deposited from the ethereal solution in brilliant colourless plates, which melt at 75°. The liquid enters into ebullition and boils constantly at 213·5°, the bulb and the stem plunging into the vapour. *Liquid xylenol*, $C_8H_{10}O$.—This is a colourless, powerfully refracting liquid, possessing a strong odour of phenol. Its density at zero is 1·036. It boils at 211·5°, under a pressure of ·7597m., the thermometer as before. Xylenol is miscible in all proportions with alcohol and ether; it is very slightly soluble in water and is itself able to dissolve a small quantity of water. M. Wurtz reminds chemists that this isomerism should be able to exist in the case of xylene itself, according to the beautiful theory of M. Kekulé.

Watts's *Dictionary of Chemistry* has been very favourably reviewed in *Les Mondes*. You will doubtless feel flattered to hear that Father Hamy, to whom M. L'Abbé Moigno had surrendered the task of examining this work, noticing your review, referred in eulogistic terms to the Chemical News. He said, "Since I have mentioned this journal I cannot refrain from recommending it to all who pursue the study of chemistry; it is a very excellent weekly journal."

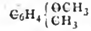
Chemical Promotions.—In our last issue we appended a note to the paragraph on Chemical Promotions, stating that Dr. Russell would probably fill the vacancy at St. Mary's Hospital. We have since been informed that other well-known chemists are in the field; from this it is evident that until the election has taken place it will be impossible to say who will fill the chemical chair in the room of Dr. Matthiessen.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

On the Vapour Density of Ammonic Sulphide.—A. Horstmann has made some experiments on the vapour density of ammonic sulphide, according to Bunsen's method (*Ann. Chem. Pharm.*, cxli., 273), the results of which differ from those obtained by Deville and Troost (*Comptes R.*, lvi., 895). He finds that ammonia and sulphuric hydride, at the temperature employed in his experiments—ranging from 56·4° C. to 58·9°—do not combine, in whatever proportion they are mixed.—(*Ann. Chem. Pharm.*, vi., Suppl. 74.)

Note on Phosphoric Sulphochloride.—A. von Flemming.—Phosphoric sulphochloride, as obtained by treating sulphurous chloride with phosphorus, and distilling the product of the reaction (*Chevrier, Journ. de Pharm et de Chem.* (4), v., 117), is not pure. It may, however, be rendered chemically pure by shaking it with little water. The heavy layer which collects underneath the water is dried at 110° C., and distilled.—(*Ann. Chem. Pharm.*, cxlv., 56.)

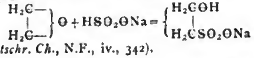
Synthesis in the Aromatic Group.—W. Körner.—1. *Synthesis of Anisic Acid.*—Analogous to the oxidation of nitrotoluol to paranitrobenzoic acid, the similarly constituted cresolmethylic ether



$$C_6H_4\begin{cases}OCH_3\\CH_3\end{cases}$$

may be oxidised to methylparoxybenzoic acid, *i.e.*, anisic acid. The author prepares cresol by boiling sulphate of diazobenzol, derived from toluidine, with water; and the methylic ether of cresol by treating cresol-potassium with methylic iodide and methylic alcohol. The ether is oxidised to anisic acid by means of potassic dichromate and dilute sulphuric acid. 2. *Synthesis of Methyloxybenzoic acid.*—This acid has been obtained by the simultaneous action of sodium and carbonic dioxide upon the methylic ether of mono-bromphenol, and its identity with Graebe's and Schultzen's acid, from oxybenzoic acid, proved. As there are three mono-iodphenols known, the author considers it probable that there will be also three monobromphenols; so that it would be possible to derive from phenol oxybenzoic acid as well as para-oxybenzoic and salicylic acid. 3. *Synthesis of the Cresol belonging to Oxybenzoic Acid.*—On treating a mixture of methylic ether of monobromphenol with methylic iodide and anhydrous ethylic ether a reaction takes place, during which principally anisol and the methylic ether of a new cresol is formed. This ether boils at 175° C.; potassic dichromate oxydises it to methyloxybenzoic acid; iodhydric acid liberates the new cresol. 4. *Mono-iodtoluol and Para-iodbenzoic Acid.*—The author prepares monoiodtoluol by treating sulphate of diazotoluol with iodhydric acid, washing the product with an aqueous solution of potassic hydrate, and distilling. It crystallises like naphthalene, fuses at 35° C., and boils, without decomposition, at 211·5°. A mixture of potassic dichromate and diluted sulphuric acid converts it readily into a new acid, para-iodbenzoic acid, which is isomeric with iodbenzoic acid. The acid, when pure, crystallises well, is almost insoluble in boiling water, readily soluble in boiling alcohol. It begins to sublime at 230°, but does not fuse at 250°.—(*Bull. de l'Acad. Belg.*, 1867; *Inst.* 1868, 54.)

New Synthesis of Isethionic Acid.—E. Erlenmeyer and Darmstädter.—The sodic salt of this acid is readily formed by heating oxide of ethylene with a solution of sodic disulphite, in a sealed tube up to 100° C. The following is the reaction which takes place:—



$$\left.\begin{matrix}H_2C-\\ |\\ H_2C-\end{matrix}\right\}O+HSO_2ONa=\begin{cases}H_2COH\\ \quad|\\ H_2CSO_2ONa\end{cases}$$

—(*Zietschr. Ch.*, N.F., iv., 342).

Investigations on Alcoholic Fermentation.—T. Oser.—The author found amongst the products of fermentation of cane sugar and yeast, an alkaloid to which he gives the formula $C_{13}H_{20}N_4$. The chlorhydrate of this base, as obtained by evaporation in vacuo, appears as a white mass of a leafy structure, is very hygroscopic, and has a powerfully bitter taste. The base does not pre-exist in yeast, but is formed during the fermentation; from this it follows that it will be contained in all liquids having undergone alcoholic fermentation, as in wine, beer, &c.—(*Akad. z. Wien*, 1867, 209.)

NOTICES OF BOOKS.

A Treatise on the Metallurgy of Iron, by H. Bauerman, F.G.S., &c.—London: Virtue & Co.

In the preface the author states his book to have been written with the view of supplying a work available for the technical education of those to whom an accurate knowledge of the physical properties of ores, and of the latest and most approved means of reducing them to the condition required by the manufacturer, has become an imperative necessity, in order to enable them fully to meet foreign competition.

The two great and inseparable questions—technical education and foreign competition—have lately been ventilated in public papers and speeches, as well as demonstrated *ad oculos* by the different international exhibitions of arts and industry, and we feel ourselves justified in advocating even further advances in technical education than have yet been made. The inferiority of our technical education, as shown by comparison with that in foreign countries, may be attributed to the insufficiency of our technical literature, and for this reason every literary contribution having a tendency to supply this deficiency should be hailed with pleasure and satisfaction.

Mr. Bauerman's treatise gives a fair view of the theory and practice of iron manufacture in all its branches, duly including the two great improvements of recent days, namely, the Bessemer process, and Siemens's regenerative gas furnace, which will doubtless form a new epoch in iron manufacture. All the different branches of iron manufacture have been discriminately treated of, as far as the limited compass of the compendium would allow; we only regret that the number of illustrations is rather limited. Upon the whole, we are of opinion that Bauerman's work is a valuable addition to the library of English educational scientific works.

On Aniline and its Derivatives: a Treatise upon the Manufacture of Aniline and Aniline Colours. By M. Reimann, P.D., L.A.M. To which is added, in an appendix, "*The Report on the Colouring Matters derived from Coal Tar, shown at the French Exhibition,* 1867." By Dr. A. W. Hofmann, F.R.S., MM. G. de Laire and Ch. Girard. The whole revised and edited by William Crookes, F.R.S., &c. London: Longmans, Green, and Co. 1868. Pp. 164.

The German treatise of Dr. Reimann possesses nearly every merit which can distinguish a book intended for manufacturers. It is very lucid and simple, it presupposes nothing but an elementary knowledge of chemistry, and it is so well arranged that all the information it contains is accessible in a minute. It is eminently practical, and yet contains enough theory to render the fact comprehensible, and to give the memory a grasp upon it. The French Exhibition report is, of course, super-excellent, and affords a curiously apposite completion to Dr. Reimann's work. Dr. Hofmann's luminous and vivacious style, so well known to all English chemists, is apparent throughout, and gives a kind of sparkle even to the recital of dry scientific facts. He has the somewhat rare power of enlivening every subject which he touches, without sacrificing scientific precision, and without ever verging upon flippancy.

It is, for obvious reasons, impossible for us to comment upon the manner in which the English editor of these two good books has done his work. Many of his readers will be abundantly able to sit in judgment upon him, and he will be perfectly contented to accept their award of praise or blame. Our duty will be sufficiently discharged if we give a brief sketch of the contents of the volume, together with a few extracts by way of example.

Dr. Reimann's treatise is divided into ten chapters, in which the various products are discussed as nearly as possible in the order of manufacture. Chapter I. is devoted to Benzol, its composition, mode of preparation, &c. The author has said very little of the process of distillation, because, as he remarks, it is seldom performed by the aniline manufacturer. Nitrobenzol is considered in chapter ii., and its manufacture is illustrated by drawings of the apparatus employed. Chapter iii. introduces the reader to Aniline. Many methods of preparing the base are mentioned; and Béchamp's well-known process is described in detail, and illustrated by a drawing. Among the less generally known methods, that of Kremer may be mentioned.—

"In 1863, M. Kremer found that aniline might be obtained by heating nitro-benzol with water and zinc powder as obtained in zinc manufactories, oxide of zinc being formed. From 100 parts of nitro-benzol he obtained from 63 to 65 parts of aniline. Zinc powder being at the present time cheap, this method may possibly be economically employed."—(P. 17).

The author distinguishes the aniline oil from light benzols as *Kuphaniline*, and that from heavy benzols as *Baraniline*; and he gives the following very simple directions for ascertaining their relative proportions roughly in any given sample of aniline oil.

"I put 100 cubic centimetres of kuphaniline in a glass retort, which I placed in a bath of oil or paraffin heated by a lamp. The tube of the retort was joined to a Liebig's condenser, and at the extremity of the condensing tube I placed as receiver a graduated cylinder by which the number of cubic centimetres of distillate could be observed. Of course the condensing apparatus was supplied with cold water. Having placed a thermometer in the neck of the retort, I began to heat.

"At first some drops of liquid, consisting of benzol, a little aniline, and water, distilled, so that when the mercury in the thermometer had risen to 180° C., 8½ cubic centimetres had distilled, of which 2½ were water, and the rest a mixture of benzol with a little aniline and odorine. By continuing the heating the oil distilled in large quantities, so that when the thermometer had risen to 185°, 54 cubic centimetres had distilled between 180° and 185°. Up to 190°, 34 cubic centimetres distilled, so that the remaining oil was only 3½ cubic centimetres. Of course another sample of kuphaniline oil will not yield precisely the same numbers, but they will be at all events similar to those above mentioned.

"When baraniline is heated in the same manner up to 190°, from 100 cubic centimetres of the oil 3½ will be distilled, of which two are water and the rest aniline oil, with a little undecomposed benzol. Between 190° and 195°, 8 cubic centimetres distil; then up to 200°, 18; from 200° to 205°, 39; from 205° to 210°, 19; from 210° to 215°, 7 cubic centimetres; 5½ remaining in the retort.

"Now, if we compare the quantities of both oils distilled at different temperatures, we shall find a great difference; so that by distilling in the above manner it is absolutely impossible to mistake a kuphaniline for a baraniline, and *vice versa*."—(P. 27).

By referring to a table given on page 30, the proportions of the two oils can be inferred. Chapter iv. deals with Magenta. It is very long, and, although one of the most important in the book, affords few passages suitable for quotation. To some readers the following may be new:—

"Every aniline salt yields magenta when heated with pure aniline to 150° C. Sulphate of aniline, heated to 200° C., turns to a violet black, and then yields, when treated with water, a solution of magenta. In a similar manner, hydrochlorate of aniline is transformed into a red colour, by heating it dry, and mixed with sand or fluor spar, for three hours to a temperature of 180° C.

"To produce magenta in this manner on a large scale, according to M. Delvaux, one equivalent of hydrochlorate of aniline is mixed with tenfold its weight of sand, and one equivalent of aniline. After agitation, the mixture is heated for fifteen hours, at from 110° to 120° C., or five to six hours to 150°, or two to three hours to 180°. The mass so treated is then put into boiling water, by which a large quantity of the red colour is dissolved out."—(P. 47).

The chapter concludes with an account of leukaniline and chrysaniline.

Chapter v. brings us to aniline blue and violet. The methods of Perkin and Church, Kœchlin, Béchamp, Crossley, Beales and Kirkman, Phillips, &c., are described, and afterwards the much more important processes in which the colour is obtained by the alteration of salts of rosaniline. The following remarks upon Hofmann's violet will be found interesting:—

"The iodide of methyl, amyl, propyl, or capryl, may be used instead of the iodide of ethyl in the above process, and instead of iodine, bromine may be used. The new violet has a richer colour, and its shades are brighter, than those of the common aniline violet. It was at first manufactured by the firm of Simpson, Maule, and Nicholson, to whom the patentee sold his privilege. Soon after, a German manufacturing chemist, Mr. Rudolph Knosp, of Stuttgard, began to make this violet, and it is now made by every continental manufacturing chemist. When dry it has a splendid metallic lustre. It is sold also under the name of *primula*.

"In the manufacture of Hofmann's violet on the large scale, the proportion of iodide of ethyl is considerably diminished, in order to save the expense of the iodine. According to my own researches, 12 parts of iodide of ethyl are sufficient to transform 16 parts of magenta into Hofmann's violet.

"It is remarkable that German chemists did not at first succeed in producing the blue shades of violet, which are so easily obtained in England, and the bluish shades could only be produced by using iodide of methyl instead of iodide of ethyl. This interesting point is easily explained, for the methyl substitute formed by using iodide of methyl is of an intensely blue colour. It was not necessary for English chemists to make a direct use of this methyl compound, since at the exorbitant price of alcohol the much cheaper methyl-alcohol was always used in England to dissolve the magenta and to render it capable of transformation."—(P. 71).

The four next chapters are occupied respectively with green, black, yellow, and brown dyes, and would yield many quotations if we could spare room for them. Lastly, chapter x. gives some directions for the determination of the tinctorial power and intensity of the aniline colours, together with a short account of Pohl's method of distinguishing aniline colours from one another, and from similar colours when on the textile fabric, by means of strong and dilute hydrochloric acid.

The Exhibition Report is crowded with interesting matter from beginning to end, and our only difficulty is to know where to choose our quotations. We select the following passages almost at random:—

"In France three millions of tons of coal are carbonised annually to supply coke for metallurgical purposes When the process of MM. Pauwels and Knab is more generally adopted there will be collected from this 125 or 130 millions of kilogrammes of tar, which would yield 2 or 3 millions of kilogrammes of light hydrocarbons. It may therefore be predicted that the price of benzols will fall still more, and that consequently the cost of colouring matters derived from it will be reduced. These prices are at the present time from 70 to 80 centimes the kilogramme for benzol; in 1862 it was worth 3 or 4 francs the kilogramme. Aniline, which then cost from 12 to 18 francs, is now worth 2·25 francs, or 3·5 francs at the maximum. Crystallised hydrochlorate of rosaniline has fallen from 250 or 300 francs to 25 and 30 francs. The blue, which was formerly sold at 500 francs, is now offered at 100 francs, and inferior qualities cost only 30 or 40 francs. These figures prove in a most convincing manner the enormous progress realised by the aniline colour industry since 1862."—(P. 104).

"*Night Blue*—The term night blue (*bleu lumière*) is given to a blue entirely free from violet, and which preserves its clear blue colour in artificial light. It is nothing more than a perfectly pure salt of triphenylrosaniline. To obtain it a good purified blue is taken, such as is given by the preceding process. After several washings with warm alcohol, the residue is reduced to fine powder, dissolved in boiling alcohol, and the solution filtered. To the clear liquid is added ammonia, or, better still, an alcoholic solution of caustic soda; all the blue is precipitated in the state of base. When the ammoniacal or sodic alcohol solution is quite cold, the triphenylrosaniline is collected on a filter, washed once or twice with boiling water, and then treated with the necessary quantity of acid to form a salt. It will be seen that this operation is extremely simple and gives satisfactory results."—(P. 127).

"A dyer, like all others of his craft at that time, was busily occupied experimenting with the aniline dyes. Amongst other things he tried a reaction which had been described by M. Lauth at the end of 1861, viz., that of aldehyd on a sulphuric solution of aniline red. In this reaction, a substance is produced which gives to solutions an extremely evanescent blue colour. M. Lauth had given up all idea of utilising this blue colour in practice; and M. Cherpin endeavoured to fix the same colour on silk or wool with similar want of success. His attempts, although fruitless, were incessantly renewed, exhausting his purse, but not his patience. One day, however, discouraged at the want of success attending some recent experiments on which he had founded great hopes, he was on the point of relinquishing the attempt at conquest over this fugitive blue, when the idea struck him to confide his troubles to an old friend, a photographer. 'A trouble shared is a trouble halved,' says the proverb; Cherpin proceeded to test this saying, and experienced the reward of his perseverance and his confidence in the consolations of friendship. He found his photographic friend, and confided to him the history of all his hopes, his experiments, and his fruitless results.—'Fix the blue?' said his friend. 'Is that the only difficulty? Why it's the easiest thing in the world! Have you tried hyposulphite of soda?"—'Hyposulphite of soda? *Mon Dieu*, no! Do you think it will fix my colour?'—'Of course it will. Don't you know that hyposulphite of soda is the fixing agent *par excellence*, and that when we want to fix anything in photography, that is the substance we always employ?'

"Happy he who possesses faith! Cherpin tried hyposulphite of soda, and his joy and admiration of the chemical knowledge of his friend may be imagined when he saw his blue colour metamorphosed into a splendid green, this time perfectly stable. It is scarcely necessary for us to add, that the mode of action of hyposulphite of soda in this case is entirely different from its photographic action, and that it would be quite impossible to predict the one by knowing the other.

"This ancedote contains a moral. It shows, in our opinion, not the result of chance,—for that is common to all the world, for where is the discovery to which chance has not more or less contributed?—but it shows the power of the will, the power of perseverance. Chance only favours two kinds of persons; those sufficiently instructed, or endowed with talents eminent enough, to observe it, to seize it, and to profit by it; and those who, by patience, perseverance, and the power of their will, force it in time to become useful to them."—(P. 133).

"The greatest uncertainty still exists as to the chemical constitution of aniline green. We are, however, justified in hoping that this will soon cease to be the case; aniline green is now a commercial substance, manufactured on a large scale, and is becoming more and more pure every day. After having presented to science a problem, without furnishing the data necessary for its resolution, manufacturing industry is working to fill up the gap, and everythings leads us to anticipate a successful result."[*]—P. 136).

A final quotation from the reporter's introduction will form an appropriate termination to our notice of this record of some of the most striking gifts of science to civilisation which the world has ever witnessed:—

"Thus, rosaniline has become the parent of a whole series of colours, and last of all of a green. The gamut of colouring matters derived from aniline is now complete; we have red, orange, yellow, green, blue, indigo, and violet.

"Are we not justified in saying that the manufacture of artificial colouring matters, in spite of the improvements of which it is yet capable, in spite of the discoveries which will yet enrich it, and scarcely ten years old, has emerged from the state of infancy, and become one of the most important industries of the age?"—(P. 100).

CORRESPONDENCE.

CORNISH MINERALS—WOODWARDITE.

To the Editor of the Chemical News.

Sir,—As there will be no meeting of the Chemical Society for some months, will you allow me to say a few words in your columns with reference to the recent discussion on Woodwardite?

I much regret my unavoidable absence from the meeting at which my "Mineralogical notices" were read. The speakers, who appear to have criticised somewhat adversely my views as to the rank of Woodwardite as a species, do not seem to have read my original paper on that subject. In the examination of this mineral, as well as of others which I have described, every possible precaution has been taken to secure an accurate result. Really distinct specimens have been analysed, their physical characters have been minutely ascertained and described, and their modes of occurrence have been studied, as far as practicable. As I have always taken, in describing new minerals, the very obvious precautions suggested by my critics, their criticism is inappropriate.—

I am, &c.,

A. H. Church.

The Lizard, Cornwall,
July 9th, 1868.

MISCELLANEOUS.

Demonstratorship of Chemistry, King's College, London.—The post lately vacant by the resignation of Dr. Edmund Cook, who leaves for India, has been filled up by the appointment of Mr. J. T. Bottomley, M.A., of Queen's University, Ireland.

Testimonial to Mr. Thomas Hall.—Within the last few days a complimentary certificate, handsomely engrossed on parchment, has been presented to Mr. Thomas Hall, in recognition of his services in the cause of scientific education. The signatures appended to the document are chiefly those of Mr. Hall's past pupils who have identified themselves with the medical and chemical professions. The text is as follows:—

"London, May 1st, 1868.

"We, the undersigned past pupils of Mr. Thomas Hall, B.A., F.C.S., have much pleasure in recording our high sense of the practical value of the system of scientific instruction inaugurated twenty-one years ago at the City of London School. Conscious of the direct benefits we have ourselves derived from attending Mr. Hall's lectures on chemistry and other branches of experimental science —many of us having, indeed, adopted a scientific profession in consequence of such early training—we gladly avail ourselves of the privilege of offering testimony to the success which has attended the efforts of our first teacher, and of certifying to the high qualifications which that gentleman has brought to bear upon the diffusion of scientific knowledge. The progress made by his pupils since the study of chemistry, has been extended so as to become a branch of general education in the City of London School, is such as to warrant the assertion that Mr. Hall's efforts have kept pace with the increased demands of a larger number of pupils.

"(Signed)

"W. H. Perkin, F.R.S., Sudbury, Middlesex; John Spiller, F.C.S., Assistant Chemist in the War Department; Wm. Thorpe, jun., F.C.S., Rivers Commission Laboratory; C. W. Heaton, F.C.S., Professor of Chemistry in Charing Cross Hospital; Edmund A. Cook, Ph.D., F.C.S., Demonstrator of Chemistry in King's College, London; W. H. Deering, Chemical Department, Woolwich; Thomas Bloxam, F.C.S., Lecturer on Science, Cheltenham College; Wm. Cawthorne Unwin, B.Sc., A. Inst. C.E., Homerton; J. James Ridge, B.A., B.Sc., L.R.C.P., M.R.C.S.E., London; William Spiller, F.C.S., Atlas Chemical Works, London; James Craik, Royal College of Science, Dublin; Henry Matthews, F.C.S., Analytical Chemist, 60, Gower Street, London; Edward Divers, M.D., F.C.S., Lecturer on Chemistry under the Committee of Council of Education in Ireland, and Lecturer on Chemistry at the Albert Veterinary College, London; Jas. T. Brown, F.C.S., Chemical Works, Greenford Green: Thomas Dale, M.A., Fellow of Trinity College and Examiner in Applied Science in the University of Cambridge; Edmund Ledger, B.A. Lond., M.A. Cantab, Rector of St. Peter's, Duxford; T. S. Aldis, B.A., Mathematical Master, Elizabeth College, Guernsey; Frederick Jas. M. Page, Royal School of Mines, London; Augustus Constable Maybury, Associate of the Royal School of Mines, B.Sc. Lond., M.R.C.S., &c., and Resident Medical Officer and Secretary to the Chelsea, Brompton, and Belgrave Dispensary; Alexander Pedler, Laboratory, Royal Institution of Great Britain; Augustus A. Wood, F.C.S., Associate of King's College, London; Frank Clowes, Royal College of Chemistry, London."

Legislation and Adulteration.—One of the measures still before Parliament is a bill which proposes to render penal the adulteration of articles of food, drink, or medicine. Every person who shall adulterate or order adulteration to be practised is to be fined on being convicted, and imprisoned for a second offence. The vendor who knowingly sells an article with which anything injurious to health has been mixed, or who sells as pure an adulterated article, is to be fined on conviction, and for a second offence exposed by advertisement. Vestries and district boards are to appoint salaried analysts and inspectors; purchasers of any article may demand an analysis on payment of a fee of one to five shillings; and convicted persons have the right of appeal to quarter sessions or a superior court. The object is laudable, but the measure would probably prove inoperative. How can the adulterator be caught at his work? Who can prove that the vendor of an impure article is cognisant of the adulteration? Why limit punishment to those who adulterate with materials injurious to health? Why not imprison the man who steals money from our pockets, and keeps health from our children by selling water at the price of milk, or starch for arrowroot? Why permit a dishonest tradesman to sell any quantity of adulterated goods so long as he does not say they are pure? Then the appointment of analysts is to be left to vestries and boards composed for the most part of men engaged in business—men, therefore, whose interest lies in the opposite direction. And what purchaser will care to prosecute, when, having already contributed by rate to the salaries of special officers, he must pay a special fee, attend at petty sessions, and probably again at quarter sessions or a superior court? If this bill became law it is to be feared that the sole effect would be that dishonest people would thereby be instructed in the art of adulterating goods according to Act of Parliament, and the public be prevented from prosecuting by the expense and trouble attending the process. We cannot doubt that a far better measure might be framed if competent men were consulted.—*Express.*

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[*] "Dr. Quesneville informs us that since the publication of this report MM. Girard and de Laire have obtained aniline green in the crystallised state, giving the most brilliant results in dyeing."

[The bill has, we believe, been abandoned.—*Ed. C.N.*]

Preparation of Thallium from the Liquors of the White Vitriol Works and Lead Mines at the Lower Hartz.—At the Herrog-Julius Works, near Rammelsberg, Brunswick, occurs a mineral rich in zinc and lead ore (sulphides of the metals); after having been once roasted, this ore is lixiviated with water, yielding a solution of white vitriol, sulphate of zinc, of 1·441 specific gravity at 24° C. This liquor, of which thousands of hundredweights are to be had, is so rich in thallium, that, according to Bunsen, this metal may be obtained from the liquor by the pound weights. The following represents the composition in 100 parts of this fluid:—

Sulphate of zinc	21·740
,, protoxide of manganese	8·230
,, magnesia	0·717
,, potash	0·581
,, cadmium	0·536
,, soda	0·443
,, protoxide of iron	0·386
,, copper	0·285
,, lime	0·075
,, alumina	0·060
,, lead	0·008
,, lithia	trace
Arsenious acid	trace
Oxide of antimony	trace
Phosphoric acid	trace
Chloride of thallium	0·050
Hydrated sulphuric acid	0·119
Hydrochloric acid	0·009
Water	66·761
	100·000

According to Bunsen, thallium is best obtained from this liquor by precipitating, by means of metallic zinc immersed in the liquor, the metals copper, cadmium, and thallium, jointly. The metallic spongy mixture thus obtained is rapidly washed—first with water, by being placed in a bag made of woollen fabric; next, some sulphuric acid is added to the wash-water, whereby the metals thallium and cadmium get dissolved with evolution of hydrogen, while copper is left untouched; from the acid solution so obtained thallium is precipitated, by means of iodide of potassium, as a pure yellow iodide, which is further purified by washing and by decantation; from the remaining liquor cadmium is precipitated in the metallic state by zinc. One cubic metre of the above liquid yields in a few days 6·4 kilos. of spongy metallic precipitate, containing 4·2 kilos. cadmium, 1·6 kilos. copper, and 0·6 kilo. thallium, 7·4 kilos. of metallic zinc becoming dissolved. The solution of cadmium and thallium in sulphuric acid yields, on addition of 0·5 kilo. iodide of potassium, 0·97 kilos. of iodide of thallium. Thallium may be precipitated from the sulphuric acid solution by means of chlorides, but in so doing a not inconsiderable quantity of the metal is retained by the cadmium. The thallium may be directly obtained from the first liquor at once by precipitation with iodide of potassium, provided previously a sufficient quantity of hyposulphite of soda be added to keep the copper in solution; the application, however, of this latter method interferes with the object for which the liquor is prepared, viz., the making of sulphate of zinc.—*Polyt. Centralbl.*, 1868, No. 10.

CONTEMPORARY SCIENTIFIC PRESS.

Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Annalen der Chemie und Pharmacie.

April, 1868.

C. Graebe, "Researches on the Quinone Group. On the Addition Products of the Aromatic Compounds." C. G. Wheeler, "On the Behaviour of Oil of Turpentine and Camphor towards Hypochlorous Anhydride." O. Jacobsen, "On the Sulpho-acids of the Isomers of Cumol." A. W. Hofmann, "Further Researches on a new Series of Homologues of Hydrocyanic Acid." W. Henneberg, "Note on Cellulose." J. von Liebig, "On the Use of Extract of Meat for Domestic Purposes." H. Kolbe, "A new Process for the Artificial Preparation of Urea." A. Strecker, "On the Preparation of Glycocol from Uric Acid."

Poggendorff's *Annalen der Physik.*

No. 3. 1868.

G. von Rath, "Note on a new Crystalline Form of Silicic Acid."

Bulletin de la Société Chimique de Paris.

April, 1868.

Berthelot, "A general Method for Reducing and Saturating Organic Compounds with Hydrogen." E. Bourgoin, "On the Electrolysis of Succinic Acid." H. Gal, "Researches on the Action of Chloride of Cyanogen on Zinc Ethyl." Perret, "An Improved Furnace for the Manufacture of Soda." Luthringer, "On Geranosine, a new Red Dye derived from Rosaniline."

Journal fur Praktische Chemie.

April, 1868.

H. Ritthausen, "On Vegetable Casein or Legumin." A. Kenngott, "Further Experiments on the Alkaline Reaction of some Minerals." K. Haushofer, "On Thomsonite from the Seisser Alp." Bottger, "On the Remarkable Action of Sulphuretted Hydrogen Gas on certain Chemical Substances. On the Use of Antimony as a Substitute for Carbon in Voltaic Batteries. On a Liquid for the Electro-deposition of Platinum on Copper, Brass, German Silver, &c. A Method of Preparing Zinc for receiving a Coat of Paint. On the Use of a Decoction of Quillaya Bark for Blowing Soap Bubbles for Physical Experiments." On the Preparation of a Green Oxide of Chromium. On the Use of Solutions of Shell-lac and Dammar Resin for Producing Spotted or Black Pharaoh's Serpents. On the Preparation of Paper for Producing the Firework known as 'Japanese Lightning.' A Simple Process for Preparing a Chemically Pure Oxygen Gas." H. Hlasiwetz and F. Hinterberger, "On the Decomposition of Oil of Turpentine at a Red Heat."

Bulletin de la Société d'Encouragement.

February, 1868.

"On the Methods used in La Plata for Preserving Meat for Export to Europe." Debray, "On some Apparatus an Processes founded on the Dialysis of Gases."

Dingler's *Polytechnisches Journal.*

April, 1868.

A. Ungerer, "On the Use of Strontia and of Ammonia in the Manufacture of Soda." Stockhardt, "On the Treatment of Bran with Hydrochloric Acid and Soda for the Manufacture of Food for Cattle."

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1258. W. E. Gedge, Wellington Street, Middlesex, "A new chemical product applicable to the electrical pile and to other purposes."—A communication from P. Rondel, Passage des Petites Ecuries, Paris.—Petition recorded April 17, 1868.

1444. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved mode of, and apparatus for generating gas, and mixing the same with atmospheric air for heating and illuminating purposes."—A communication from J. T. Rich, Philadelphia, Penn., U.S.A.—May 2, 1868.

1804. J. Oakden and J. Pickin, Congleton, "A new or improved material for enamelling iron, so as to prevent corrosion and incrustation."—June 20, 1868.

1921. A. L. Fleury, Boston, Mass., U.S.A., "Improvements in the means of, and apparatus for, treating gold and silver ores, and in utilising the products resulting therefrom."—June 12, 1868.

1932. C. Humfrey, Suffolk Grove, Southwark, Surrey, "Improvements in the preparation of a flexible compound applicable to waterproofing and other purposes."

1939. W. Yates, Duke Street, Westminster, "Improvements in the furnaces to be used in metallurgical operations."

1940. K. Malster, Pall Mall, "An improved mixture or compound for cleaning gloves and other articles."

1944. E. Fisher, Grosvenor Park, Camberwell, Surrey, "An improved tonic effervescing drink."—June 13, 1868.

1954. W. C. Sillar, Cornhill, London; G. Sillar, Grange Road, Upper Norwood; and G. W. Wigner, Camberwell, Surrey, "Improvements in deodorising and purifying sewage, and making manure therefrom."—June 15, 1868.

1970. J. C. Walker, Surrey Street, Strand, Middlesex, "An improved baking powder to be employed in the treatment of flour in the manufacture of bread and other farinaceous food."—June 17, 1868.

NOTICES TO PROCEED.

535. W. Perkins, Russell Place, Fitzroy Square, Middlesex, and G. G. Tandy, Anerly Road, Penge, Surrey, "An improved preparation or compound applicable for insulating electric conductors, and for such purposes as india-rubber and other vulcanisable gums are applicable."—Petition recorded February 18, 1868.

565. W. Weldon, Park Villa, West Hill, Highgate, Middlesex, "Improvements relating primarily to the manufacture of chlorine by means of regenerated oxides of manganese, but partly applicable also to other purposes, being improvements in the decomposition of chlorine residues in the peroxidation of oxides of manganese recovered therefrom, in the treatment of a bye-product of the decomposition of those residues, in the separation of sulphuric acid and other impurities from the hydrochloric acid employed, and in apparatus and arrangements for some of these purposes."—February 20, 1868.

688. J. Gjers, Middlesbrough, Yorkshire, "Improvements in the manufacture of cast steel and homogeneous iron, and in furnaces applicable thereto."—February 28, 1868.

983. E. Vignier, Fowkes Buildings, London, "Improvements in distilling and rectifying spirits, and in apparatus employed therein."—March 23, 1868.

1892. C. W. Siemens, Great George Street, Westminster, "Improvements in the manufacture of cast steel, and in furnaces and apparatus employed for that purpose."—June 10, 1868.

NOTES AND QUERIES.

Sulphur.—I would be glad to know at what temperature sulphuretted hydrogen, given off from the cracker in which sulphate of ammonia is salted, if passed into a long flue, will deposit its sulphur—if it will so deposit it; and how much sulphur escapes from 1000 lbs. vitriol, Sp. Gr. 1·720?—Querist.

Potato Powder.—First get the potatoes well washed, then slice them, and after this submit them for some time, while placed on hurdles made of wicker-work, to steam of a pressure of from four to five atmospheres, or sixty to seventy-five pounds pressure per square inch; this has the effect of very rapidly boiling the potatoes without causing them to loose in good quality. After this the hurdles containing them are placed in a room through which dry air, having a temperature of at least from 30° to 45° C. is forced by means of a fan-blast; this rapidly dries the potatoes, and if it be desired to reduce them to powder, it might be easily accomplished by first strongly compressing them so as to form solid cubes or cylinders, and to submit these to the action of rasp-mills, similar to those in use to grind snuff from tobacco.

Separation of Arsenic and Antimony.—An accurate method of separating these two bodies is founded on the fact that recently precipitated sulphide of arsenic is soluble in bisulphite of potash, while sulphide of antimony is insoluble. If, for example, we have to analyse commercial grey sulphide of antimony, or metallic antimony, it can be done as follows:—Mix the finely-pulverised and weighed substance with a little sulphur, and digest in a solution of protosulphide of potassium; the mass dissolves, generally leaving a black residue, consisting of a mixture of sulphides of lead, iron, and copper, which must be filtered off and examined separately. The liquid is mixed and digested with a large excess of water saturated with sulphurous acid, then heated and kept in ebullition till two-thirds of the water has boiled away and there is no smell of sulphurous acid. Sulphide of antimony will be precipitated, and from the filtrate from this the arsenic may be precipitated by a stream of sulphuretted hydrogen gas.—F. Wohler.

Separation of Bismuth from other Metals.—The best way to separate bismuth from other metals is based on the fact that when a large quantity of water is added to its solution mixed with hydrochloric acid a completely insoluble precipitate of oxychloride of bismuth $(2Bi_2O_3, Bi_2Cl_3)$ is obtained, which may either be weighed as such or reduced to the metallic state by fusion with cyanide of potassium. To separate bismuth from lead add to the concentrated solution just enough hydrochloric acid to precipitate all the chloride of lead, but so that a few drops of water do not render the liquid turbid. Then add dilute sulphuric acid, the slow action of which is hastened by occasional agitation; finally after having added alcohol and well mixed the whole by renewed agitation allow the sulphate of lead to deposit. This precipitate is to be filtered and washed, first with alcohol containing a few drops of hydrochloric acid, and then with pure alcohol. The bismuth may be precipitated in the filtrate by dilution with a large quantity of water.—F. Wohler.

TO CORRESPONDENTS.

Llanelly writes as follows:—"The purpose of my letter is to beg your kind advice as to whether it would be possible for me to obtain a situation where chemistry is taught or practised, and where I might gain my living and learn the art, and ultimately become a practical chemist? If so, where had I best apply? I am very little acquainted with the chemical world, but am intensely attached to the science and art. Had I plenty of means I suppose I would have but little trouble in gaining my heart's desire. I mean I might be trained in a school or college of chemistry; but this is not my lot, I must work to gain my living. I know that for a persevering mind there are few things impossible. I therefore encourage myself that, although moneyless, I may yet gain, by hard working, the position I long for. I am twenty-one years of age, have been engaged for last two years as a dispenser, &c., to a surgeon, during which time I have devoted almost all my spare time to the study of chemistry, and have got up the elements of organic and inorganic chemistry, chemical philosophy, and chemical analysis. I am really anxious, seeing that in my present employment I can never satisfy my ambition. If you will be so kind as to insert your answer in your next number of the Chemical News, stating the place where I had best apply, and my advantages and prospect in the same I shall feel extremely obliged."—We cannot take the responsibility of advising on this subject. Scientific chemistry, as an amusement for leisure hours, has no rival, but it is the worst trade you can choose. If also you have a definite object in view—some manufactory or trade in which chemistry can be made available—you will do well to persevere in its study. But having no money or prospects, and being under the necessity of working for a living, we can give you no hope of getting on. Chemistry is not yet remunerated sufficiently for it to be worth any one's while to take to it as a trade. Unfortunately its fascinations are such that hundreds are tempted to enter upon its study with the expectation of being able to earn a living at it. A very small number succeed, but the majority seldom get as much as would satisfy a respectable mechanic or clerk. When an appointment is advertised which will bring in £300 a year, there are 100 applicants; and one in which the expenses of the office are expected to exceed the income is even sought after, if it is likely to prove a stepping stone to something better.

F. J. R. (Glasgow).—A letter to the gentleman, addressed to our office, will be forwarded. Lehmann's Physiological Chemistry will give you the analyses you require. See also Watts's Dictionary.

An Icicle.—You ought not to require a freezing mixture. One of the best mixtures consists of equal parts of nitrate of ammonia and water. When dissolved a great reduction of temperature takes place. Use a preliminary mixture to cool down the nitrate of ammonia, water, and vessels you intend to employ in the actual operation, and the temperature obtained will be correspondingly lower.

Physician.—It is quite true. Professor Church's paper on the occurrence of arsenic in a potable water, habitually used for every purpose by the inhabitants of a village in Cumberland, will be found at page 127 of our second volume.

Communications have been received from W. W. Abbot (with enclosure); Professor Church (with enclosure); T. Graham, F.R.S. (with enclosure); Dr. Divers; G. F. Rodwell; W. Brown (with enclosure); H. Seward; J. Trehame; A. B. Northcote; E. Owens; W. Archer (with enclosure); J. Attfield (with enclosure); W. Little; F. J. Rowan; Dr. F. C. Calvert, F.R.S. (with enclosure); U. J. Kay-Shuttleworth; W. Briggs; J. Nimmo; G. W. Eccles; Gaskell, Deacon, & Co.; J. Livesey; C. Dixon; C. F. J. Lord; J. Horsley; J. H. Freeman (with enclosure); E. P. H. Vaughan; Fannin & Co. (with enclosure); H. Baillière; Longmans & Co; Dr. Röhrig; J. Spiller (with enclosure); J. Greenwood; J. J. Vaughan (with enclosure); and H. R. Williams.

THE CHEMICAL NEWS.

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ON SOME OF
THE CONSTITUENTS OF COAL GAS.*

A Lecture by Dr. ODLING, F.R.S., F.C.S., &c., before the British Association of Gas Managers.

Ever since the French Exhibition of last year there has been much public talk and discussion about the decline of English scientific manufactures, especially in relation to those of the Continent. It has been asserted very boldly that we in this country—where gas lighting took its origin, where the first locomotive ran, and where some of the earliest and greatest successes of the electric telegraph have been achieved—are not making such a degree of progress in scientific manufactures as continental nations are. Now, whether this be the fact or not—and for my own part I am by no means disposed to admit it as a fact—the circumstance of such an allegation being made is, I conceive, a warning to us that we must for the future devote our best energies and wisest consideration to the development of our different scientific industries. Now-a-days the universal panacea for every shortcoming appears to consist in the establishment of what are called technical schools. It is difficult for outsiders to form an exact notion of what is to be the character and purpose of these technical schools, but the prevalent opinion, as I understand it, is something of this kind. Hitherto our mode of teaching young men the business of their future lives has been altogether wrong, and we must at once resort to an entirely different system. Instead of letting them learn their business at factories where work is done for a profit —where it is done in the only way in which it can be done on a large scale, and for useful purposes—they are to learn their business at special schools, where all work is to be done solely or primarily with a view to education. Henceforward, instead of gas managers learning the business of gas manufacture at actual gas-works, they are to study at model gas-works; metallurgists at model smelting-works; and mechanists at model foundries and workshops. Now, in common with many of my scientific friends, and more especially Dr. Williamson, who has devoted much valuable thought to the subject, I venture to dissent very strongly from these views. I hold, and I think you will agree with me, that the only place in the world where you can learn to make gas properly is in an actual gas factory, and the only place where you can learn to make and work iron properly is at some actual iron-works. But with regard to science the case is very different; and instead of founding technical schools to teach manufacturing art, I believe it would be of much greater advantage to make the principles of science a far more prominent subject of study at our ordinary schools, so that when young men enter upon their work as manufacturers, they may be able to apply to their respective businesses the exact scientific principles which they will have acquired by the study of abstract science elsewhere. Let science, then, be taught in schools, and the application of science in works conducted on ordinary commercial principles.

These remarks are preliminary to what I have to say to you this evening. I do not come here pretending to teach you how to make or purify gas, for you know that much better than I do; but, inasmuch as gas-making is your business, and chemistry is mine, I want to tell you a little about the mere chemistry of your manufacture, and possibly throw out a hint or two that you may be able practically to apply. I wish to point out to you the purely chemical qualities of some of the bodies with which you are dealing, leaving you to make the application of the knowledge, as you are so well able to do. And, even in this limited matter, I am placed in considerable difficulty, for I find that my friend, Dr. Letheby, has gone pretty nearly over the whole of the ground in his previous lectures to you. I have read four of those lectures, and certainly with a great deal of profit, but I cannot say altogether with pleasure, for it is not a pleasant thing to find that, if not all, at least the finest plums have been already plucked from the tree. I can only attempt, therefore, to go a little more into chemical detail than Dr. Letheby has done with regard to some of the principal constituents of coal gas, and I purpose confining my attention almost exclusively to those constituents which do not contribute very largely to its illuminating power.

The first of these to which I will direct your attention is hydrogen. Hydrogen is an important constituent of ordinary coal gas, and its proportion varies very considerably in gases of different manufacture. It ranges from 12 to 50 per cent, and more frequently approximates to the higher than to the lower quantity. In ordinary London gas the proportion is usually about 40 per cent. Hydrogen gas is characterised by its burning with an almost invisible flame. I have here a jet of the burning gas, but, unless I introduce into the flame a piece of platinum wire, I doubt very much whether those gentlemen who are sitting at a distance can distinguish it; and, even with the piece of platinum inserted, the flame is scarcely visible.

In addition to the non-luminosity of its flame, hydrogen is very interesting, for this reason, that it is the only constituent of coal gas which, whether burned at a high or a low temperature, with excess or deficit of air, yields the same product of combustion. I want to give you an illustration of the mode of burning hydrogen at a low temperature, and that I can readily do by bringing into contact with the pure gas as it issues from the jet a piece of platinum sponge mixed with a considerable proportion of clay. On bringing this into contact with the hydrogen, you see that the ball of platinum clay soon becomes feebly red hot. Under these circumstances a small portion only of the issuing hydrogen is being burned, but that small portion so burned is being as completely converted into water as it would be in the oxyhydrogen blowpipe. At present the platinum ball, though very hot—just below a dull red heat—is not sufficiently hot to inflame the hydrogen. In order to effect the inflammation we must bring the light of a flame into contact with the gas, when it at once takes fire, as you perceive. This is the only point upon which I have to offer any remark on the subject of hydrogen—viz., that it may be burned at a high or low temperature, with flame or without, but the product of combustion is always the same,—viz., water.

The next constituent of coal gas to which I shall refer is marsh gas, the most abundant, indeed, of all the constituents. It forms generally from 30 to 60 per cent by volume, and burns with a pale luminous flame. We have here some marsh gas, though not quite pure, and you observe that it burns with a yellowish flame, having but a slight luminosity. I now want to give you an illustration of the mode of burning this gas at a low tempetature. In this case, instead of employing platinum sponge, I shall employ a piece of platinum foil. There is, you perceive, a very considerable degree of heat produced during the operation, but not sufficient to inflame the marsh gas, although the platinum foil becomes distinctly red hot. Now, when marsh gas is burned thoroughly, it yields products which consist almost entirely of carbonic acid and water; but when it burns in this way it gives rise to ill-defined products, which have an acid reaction, a disagreeable smell, and a power of reducing certain metallic salts. It is of very great importance in burning coal gas that you should get as thorough a combustion as possible, because all these half-burned products have an offensive smell, and it is to their presence that the smell of artificially-illuminated rooms is due.

I will now repeat this experiment with the platinum foil, but instead of taking marsh gas I will employ hydrogen, and you will see that directly I bring the foil into contact with it the gas inflames, the hydrogen being much more easily set fire to than the marsh gas. It is a striking property of hydrogen, as compared with marsh gas, that the degree of temperature which is not sufficient to inflame the latter inflames the former very readily; but though this is true of hydrogen in a pure state, it is not true of it when mixed with the other constituents of coal gas. It is sometimes suggested that because hydrogen gas is capable of being inflamed at an exceedingly low temperature, therefore its presence renders coal gas very inflammable; but such is not the case, for though the coal gas we have here contains 40 per cent of hydrogen we may make this piece of platinum foil suspended over it exceedingly hot, and yet it will not set fire to the gas; whereas when we were employing pure hydrogen, even though the platinum became but just visibly red, it was sufficient to inflame the gas, but diluted as the hydrogen now is to a large extent with marsh gas, the far more strongly heated platinum fails to inflame it.

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* Reprinted, by permission, from the *Journal of Gas Lighting*.

And this leads me to make an observation or two upon the general nature of flame. I, who stand a little above the imperfectly burning coal gas, have the disadvantage of the smell which arises during the imperfect combustion. Some of you will remember that a little time ago, when large massive iron burners were employed for heating purposes, they also gave rise to a very offensive smell. Now, there is an impression abroad that although when gas is burned with an insufficient supply of air you do not burn it thoroughly, yet that if you burn it with an excess of air you cannot fail to effect its thorough combustion. But with all those iron burners the gas was burned with an excess of air, and the proof was that you only got a blue non-luminous flame; nevertheless you did not produce anything like a complete combustion of the gas into carbonic acid and water, as evidenced by the offensive smell of the products actually formed. The same thing frequently happens with the Leslie burner when used improperly. When a rich gas is employed, and the chimney is properly adapted, the combustion of the gas is as perfect as possible; but this is not the case in burning from a foot to a foot and a half per hour, when you only get a blue flame just tipped with yellow. Although the gas is then being burned with a large excess of air, you are, nevertheless, not so thoroughly burning the gas as when there is a less proportion of air. We shall readily see how this must be so. In every flame, you may take it, there is an interior portion or core, which is the gas itself; surrounding that is a mixture of air and gas in about the right proportion to give a luminous flame, and around that there is an external film of gas, with air in excess. In the intermediate portion of the flame the combustion is most perfect, though far from complete, and the temperature highest. The core of coal gas surrounded by this intermediate extremely hot layer is decomposed by the heat to which it is exposed just as it would be decomposed in a white hot retort. The decomposed gas is then burned to a more or less complete extent in the intermediate luminous cone—never to a complete extent, since it is always burned with a deficient supply of air, being separated from the surrounding air by the external non-luminous film in which the air is in excess. But even in this external film the perfect combustion of the residual gas is never absolutely achieved, and for several reasons—first of all, because the residual gas is mixed up with so large a quantity of air which requires to be heated to a much higher temperature than the amount of heat in the flame is capable of imparting to it; and, secondly, because the residual gas and air are also necessarily mixed up with the incombustible products of the gas that is already burnt in the luminous cone. Accordingly, in the exterior film, notwithstanding the large excess of air, the combustion is not complete, because of the cooling effected by the large excess of air, and because of the diluting effect of the products of combustion.

Now, it will be found that the complaints which arise about the closeness of rooms heated by gas arise partly from the amount of steam produced, which makes the atmosphere damp, and interferes with free perspiration, and partly from the formation of imperfectly burned products, since in all lamps and candles the combustion is never perfected. There are always some half-burned products thrown off which give rise to the sense of closeness which is not peculiar to gas, but is noticed chiefly in the case of gas, because gas being the cheapest of all illuminating agents, we are apt to burn it most extravagantly.

Now, I want to give you some experimental illustrations of the nature of flame. Here I have a flask, which is supplied with coal gas from an opening blown in its side. At the bottom of the flask is an open tube communicating with the atmosphere, and you will find in this case that we can burn atmospheric air just as well in coal gas as we can burn coal gas in atmospheric air. You see, in fact, that the combustion takes place wherever the two layers come in contact with each other. Here we are burning the gas in air; in the other case we are burning the air in gas. In each case we have in reality a shell of flame, the difference being that in the one case the air is on the outside, in the other it is on the inside. By blowing gently into the air-tube you observe that I am actually able to burn my own breath in an atmosphere of coal gas, just as I might burn a small jet of coal gas in the atmosphere of my mouth. Now, let me give you another illustration of the nature of the combustion of coal gas. We have here a cylinder of coal gas, and in it I may burn any highly-oxidised salt. I may burn, for instance, nitre. Nitre will take fire and burn in coal gas, just as a sulphur match will burn in air. In this case I am not going to burn nitre, but chlorate of potassium, which is a more convenient salt. I make the chlorate just red hot. You observe it does not burn at all in the air, but directly I introduce it into the coal gas it bursts into flame. Here, again, it is simply a question of where the two reacting bodies come in contact with each other. In ordinary circumstances we have the combustible match surrounded by oxygenous air; here we have the oxygenated salt surrounded by combustible gas.

In the Bunsen burner air and coal gas are mixed together before their combustion, whereby we get an almost solid flame; but even in this burner the problem of perfect combustion is not absolutely achieved, nor is it in the best contrivances with which I am acquainted. I believe the most perfect combustion practically attainable takes place in those luminous flames where you do not, indeed, get the maximum yield of light, but where the gas is a little over burnt with production of a very white flame, as in some of the different forms of button-burner, in Leslie's burner, &c.

The next constituent of coal gas to which I wish to call your attention is ammonia. The proportion of ammonia in London gas is very small. We find that 1 grain of ammonia in 100 cubic feet of gas is sufficient to affect turmeric paper; upon which ordinary London gas is usually without or almost without action. Ammonia is a very interesting substance to gas manufacturers. Of all the common gases—*i.e.*, of all gases which are not chemical curiosities—it is the one most soluble in water. At mean temperature, 1 cubic inch of water will dissolve 783 cubic inches of ammonia. The dissolution of ammonia in water takes place with very great rapidity. I have here a sealed glass tube, filled with ammonia gas. On breaking the end of the tube under water coloured with red litmus, you perceive that the contained ammonia is absorbed in an instant, and the tube immediately and completely filled with the water, now turned of a blue colour by the action of the ammonia. This is a very striking experiment. It would seem at first sight to warrant the notion that, since 1 cubic inch of water will dissolve 783 cubic inches of ammonia, and dissolve it at this extremely rapid rate, the removal of ammonia from coal gas must be a very easy problem. But such is far from being the fact. The tube with which I have been experimenting was completely full of ammonia, unmixed with any other gas; but the tube I now hold in my hand contains but 75 per cent of ammonia gas mixed with 25 per cent of air. And you will observe how very much more slowly the liquid will rise up in this case. It makes a very great difference in the dissolution of a gas whether we are dealing with the gas itself pure and simple, or whether we have it diluted to a certain extent with air. I now break the point of the tube under water, and you see at what a slow scarcely noticeable rate the gas gradually dissolves, and the water consequently rises in the tube; so much so, that the complete solution of the gas will scarcely be effected by the conclusion of my lecture. Here you see how great a difference it makes whether you are dealing with ammonia by itself, or whether you are dealing with what is substantially ammonia, but which contains in admixture some 25 per cent of air or coal gas. But, after all, in reference to the dissolution of ammonia in water, the difference in the rate of solution between a gas consisting entirely of ammonia and one consisting of ammonia to the extent of 75 per cent is as nothing compared with the difference between this latter and a gas of which the ammonia amounts to a few per cents only, such as that with which you have to deal.

I want to illustrate to you in another way the fact that the solubility in water of a gas by itself, and of the same gas when mixed with other gases, is a very different thing. In illustration of this, I would call your attention to the difficulty there is in dissolving up from the air substances which by themselves are exceedingly soluble. This is an empty 4 lb. bottle, and into it I am going to put a few drops of strong ammonia. Having done this I now introduce a glass rod moistened with a little muriatic acid, and by this means I shall produce an abundance of white fumes of sal ammoniac inside the bottle. The bottle soon gets full of them. Now, sal ammoniac is a very soluble substance indeed; but you will observe the difficulty which I have in dissolving up these fumes of sal ammoniac from the air in the bottle. I half fill the bottle with water, whereby, as you see, a good deal of the fume is blown out; nevertheless, though I shake the bottle about, the remainder does not disappear. You see what a difficulty there is in dissolving, not sal ammoniac itself, but sal ammoniac when forming say 1 per cent or a half per cent of air. Indeed, I have to shake up the bottle very violently and for some time with this large excess of water, in order to get rid of the fume altogether. This shows that the mere passage of any gas over a considerable extent of watery surface will not be sufficient to cause its soluble impurities to be taken up, but that long contact or considerable agitation with the water is required.

I will now give you another illustration of the same difficulty. I have here a bottle containing strong ammonia, and here another containing sulphuric acid. The sulphuric acid is very much stronger than that with which gas managers are in the habit of washing their gas. It is of about the strength of ordinary brown acid; nevertheless you will see that on blowing through the first bottle I shall get a current of air charged with ammoniacal vapour, and that, on its passage through this comparatively strong sulphuric acid, the whole of the ammonia will not be removed. You perceive that the gas which has bubbled up through the sulphuric acid has, notwithstanding, the property of browning turmeric paper; and on passing it for a few minutes through red infusion of cabbage, the red colour of the liquid is turned successively purple, blue, and finally green. The strong acid, employed in this way, is quite powerless to remove from the air the ammonia which it has taken up by its passage through the solution of ammonia. This shows how very difficult it is sometimes to remove small proportions of ammonia, not only by a substance like water, in which it simply dissolves, but even by sulphuric acid, with which it enters into chemical combination. And this is true, not only of ammonia, but of all other impurities of coal gas; when thay are reduced to small quantities it is most difficult to get rid of them entirely. The nearly pure gas requires to come into most intimate contact with the several absorbent substances employed for a considerable length of time in order to become entirely freed from impurity.

With regard to ammonia, I will show you one other experiment. Though, as I have said, this gas is so soluble that one volume of water will dissolve 783 volumes of ammonia, nevertheless it is very readily removable from water by the agency of air, or coal gas, or, indeed, any gaseous substance whatever. Accordingly you will find that even the weakest solution of ammonia will give off some of its ammonia upon agitation with a considerable volume of air. I will take two 4 lb. bottles, and half fill each of them with water. Into each of these bottles I will now suspend a piece of ordinary red litmus paper, just damped slightly. The one bottle contains pure water, and I do not expect to find the paper in it affected at all; but to the 2 lbs. of water in the other bottle I will add three drops only of solution of ammonia—*i.e.*, of ammonia gas already dissolved in about two drops of water—and yet this 2 lbs. of water will not be able to retain all the ammonia and prevent its diffusing into the air. Upon shaking up the bottle, the ammonia diffuses itself out of the water into the air above it, and in a few minutes you will see that the litmus paper (which I now suspend in the air of the bottle) has become completely blue, through the minute proportion of ammonia in the water having partially escaped into the air above it.

I will now direct your attention to the mode in which ammmonia combines with acids to form salts. Of all metallic salts chloride of sodium, or common salt, is the most familiar, and may conveniently be taken as the type. It consists of one proportion of sodium, having the relative weight 23, combined with one proportion of chlorine, having the relative weight 35. Writing each of these proportions by the symbols Na (natrium) and Cl respectively, common salt is expressed by the symbol NaCl. Now, it will be observed that common salt, or chloride of sodium differs from muriatic acid, or chloride of hydrogen, HCl, in the circumstance of its containing a proportion of sodium having the relative weight 23 instead of a proportion of hydrogen having the relative weight 1; and in a similar manner it will be found that metallic salts in general are formed from acids by the substitution of metal for the hydrogen of the acid. Thus, when muriatic acid is neutralised with caustic soda, Na HO, common salt is produced by the following reaction:—

$$\mathrm{H\,Cl + Na\,HO = NaCl + H\,HO.}$$

We begin with chloride of hydrogen, and end with chloride of sodium.

But the formation and constitution of ammonia salts are very different. In order to make sal ammoniac, or chloride of ammonium, I do not replace the hydrogen of the acid by any metallic substance whatever, but I combine the entire acid, hydrogen and all, with ammonia, thus:—

$$\mathrm{H\,Cl + NH_3 = NH_3\,H\,Cl.}$$

And similarly with regard to the sulphate, nitrate, oxalate, and other salts of ammonia, they are all of them constituted of the original hydrogen acid, or hydrated acid combined directly with ammonia.

But salts of ammonia present a very remarkable resemblance in many of their properties to ordinary metalli salts, more particularly to salts of potassium, and in a les degree to salts of sodium. Hence, some chemists are disposed to regard ammonia salts as really containing metal—not a simple metal like sodium, but a compoun metal formed by the union of the ammonia with the hydrogen of the acid. Accordingly they represent sal ammonia not by the formula $\mathrm{NH_3\,HCl}$, but, instead, by the formul $\mathrm{(NH_4)\,Cl}$; and they call it not muriate or hydrochlorat of ammonium, but, instead, chloride of ammonium. Now there is one very striking property of ammoniacal salts which, so far as it goes, is strongly in favour of this view —which really seems to show that ammonia can unite with the hydrogen of muriatic acid to form a compound metal.

The evidence is of this kind: Mercury, which is the only metal existing in the liquid state at ordinary temperatures, is capable of uniting with many other metals, but with no other bodies than metals, to form semi-liquid or pasty alloys, which are called amalgams. Gold and silver, indeed, are usually extracted from their respective ores by the process of amalgamation. The precious metals are first dissolved in mercury; the excess of mercury is then strained or squeezed off, and the soft or pasty amalgam submitted to distillation. Now, when chloride of sodium is decomposed by the galvanic battery, chlorine is liberated at one pole and metallic sodium at the other, and if this other pole be formed of a drop of mercury, the sodium, as it is set free, is taken up by the drop of mercury to form sodium amalgam. Similarly, when chloride of ammonium is decomposed by the galvanic battery, chlorine is liberated at the one pole, while there is formed at the other, in presence of a drop of mercury, an abundant amalgam, which consists of nothing but mercury, ammonia, and hydrogen. Now, since amalgams are formed only by the union of mercury with metals, the production of an ammonium amalgam is some evidence that its constituents, ammonia and hydrogen, are contained in the amalgam in the form of a compound metal.

I am able to produce this ammonium amalgam in another form, and to show it you on a somewhat large scale. I have here some sodium amalgam already prepared by dissolving metallic sodium in heated mercury, and if I now pour this amalgam into a solution of chloride of ammonium, the chlorine leaves the latter salt to unite with the sodium of the amalgam and form chloride of sodium, while the ammonium takes the place of the sodium and unites with the mercury to form ammonium amalgam. You see directly I pour in the liquid amalgam of sodium, the bulky pasty amalgam of ammonium is at once formed, which, expanding to some hundred times its original bulk from the evolution of interstitial hydrogen, speedily overflows the vessel. Accordingly, ammonia salts may be regarded either as direct combinations of ammonia (NH_3) with the hydrated acids, such as hydrochloric acid (HCl), sulphuric acid (H_2SO_4), &c.; or as derivatives of the several acids through a replacement of their hydrogen by the compound metal ammonium (NH_4). Which of these views is most correct must be regarded as an open question. Some facts are in favour of the one view, and some the other. Most chemists are now in the habit of employing both modes of representation alternatively in different cases.

Ammonia is a very interesting body in another relation altogether. It is of all uninflammable bodies the one which approaches nearest to being inflammable. Here we have, in this flask, some solution of ammonia which, upon being gently heated, furnishes us with an abundant supply of ammonia gas. On applying a light the gas burns, as you see, with a pale green flame, but on taking away the light it ceases to burn. The heat produced by its own combustion is not sufficient to maintain it in combustion, and it only burns in contact with the flame of some other body. But though it will not burn in air it will burn in oxygen gas, and I will now give you an illustration of the combustibility of ammonia in oxygen gas. On surrounding the jet of ammonia by a current of oxygen you observe that it burns I might almost say brilliantly, with its characteristic greenish yellow flame.

Why does ammonia burn so freely in oxygen gas and so difficultly in air? There are several reasons, the principal one being that when the ammonia burns in air, for every one volume of oxygen which takes part in the action, and which has to be heated up to the temperature of the flame, there are four parts of nitrogen which have also to be heated up to the same temperature, but which contribute nothing to the action or the temperature. Moreover, when burning in oxygen, the jet of ammonia is at any given instant in contact with five times as much oxygen as when burning in air. I can give you another illustration of the combustibility of ammonia gas in a somewhat different form. I take a Florence flask, and into it I pour a little strong solution of ammonia. I now place over the strong ammonia a coil of platinum wire, which is first heated just to redness. You perceive that the platinum wire exposed to the ammonia continues to glow for a considerable time; and if I now pass into the gas a rapid stream of oxygen, ignition of the wire becomes more intense by reason of the chemical combination taking place between the ammonia and oxygen, and in a minute or two it becomes so hot as to inflame and explode the mixture of gases.

The fumes remaining in the flask are an evidence of the oxidation which has taken place, not only of the hydrogen of the ammonia into water, but of its nitrogen into nitrous or nitric acid. This is an important fact with regard to the combustion of ammonia, for we shall find, when speaking of sulphur in gas, that this sulphur is oxidised by burning into sulphurous acid only, which, when sufficiently diluted, is a very innocent substance; whereas if considerable portions of ammonia are present in the burning gas, the ammonia in burning yields different oxides of nitrogen, which effect a partial conversion of the sulphurous acid into sulphuric acid. In burning ammonia, then, we find that the hydrogen of the ammonia unites with oxygen to form water, whereas the nitrogen of the ammonia is partially liberated in a free state as nitrogen gas, and partly transformed into nitrous acid. Accordingly, we always get by the combustion of ammonia a certain amount of nitrous acid, which acts as a powerful oxidising agent. In ordinary purified gas, however, the proportion of ammonia is so exceedingly minute—in most cases insufficient to affect turmeric paper at all—that this point respecting its products of combustion is not of any practical interest. There is one other mode of burning ammonia to which I will direct your attention for an instant, which has a more practical bearing. Although ammonia will not burn in air by itself, it will burn in air if mixed with some other inflammable gas. I am here burning some hydrogen gas, and now, instead of burning it directly, I will first pass it through strong ammonia, when you perceive that the size of the flame is very much increased, and its appearance entirely altered from the considerable combustion of the ammonia which the hydrogen has taken up. You see, therefore, that in removing the ammonia from your gas you do really remove a combustible, and even to some extent a luminiferous constituent of the gas.

Now, a word or two with regard to another constituent of coal gas—viz., carbonic oxide. Carbonic oxide exists in ordinary coal gas to a comparatively small extent, the proportion varying from 5 to about 15 per cent. This gas is characterised by its burning with a feebly luminous but decidedly blue flame. I have here some of it in a holder, and you see the clear blue flame by which its combustion is characterised. We will now substitute for the glass tube an ordinary burner; but though I am using the largest sized bat's-wing, I am able to get but a very small flame, carbonic oxide being a gas which is very soon burned out. Now, although carbonic oxide exists to the extent of from 5 to 15 per cent in ordinary coal gas, it exists in a much larger percentage in the gas that is produced by passing steam over ignited coke. You will remember that at one time there was a project for making illuminating gas by means of steam passed over coke. The gas so produced has itself no illuminating power, but we may give it an illuminating power by burning with it some luminiferous hydrocarbon, such as benzol, or by introducing into its flame a coil of platinum wire. Here we have a U-tube containing pumice and benzol, and we will now pass through it some of this carbonic oxide gas. You will see that it is a very excellent purveyor of the hydrocarbon, and that we thus get a very luminous flame, because carbonic oxide is the gas which, for an equal quantity of oxygen, gives out by its combustion the largest proportion of heat—larger even than hydrogen—in the proportion of 68 to 57. The other mode of giving illuminating power to the originally non-luminous flame, and which seems to some extent a considerable success, is by means of a coil of platinum wire. On holding this piece of wire in the flame it becomes of almost dazzling whiteness, and radiates light abundantly. I remember once seeing a room of the Royal Society illuminated in this manner for a few hours, and I think it is a question whether this steam gas may not, after all, be made something of. When steam passes over coke, the coke being heated merely to dull redness, there is scarcely any carbonic oxide gas produced—it is nearly all hydrogen and carbonic acid. The kind of action is shown in this equation:—

$$C+2H_2O=CO_2+H_4.$$

But when we employ a full red heat the kind of action is different. Under those circumstances we have this reaction:—

$$C_2+3H_2O=CO_2+CO+H_6.$$

So that after the removal of the carbonic acid gas by lime there is left a mixture of three volumes of hydrogen with one of carbonic oxide. There is a great prejudice against the use of carbonic oxide, from its extremely poisonous character. An atmosphere containing only 2 per cent of the gas will prove fatal to animals breathing it; but, inasmuch as gas for illuminating purposes is meant to be burned, and not to be breathed, the question is not so much with regard to the poisonousness of the original gas as of the products of combustion. The amount of gas that escapes into the air unburned is so small that its presence may be safely disregarded.

Just one or two remarks with regard to carbonic acid. Carbonic acid gas is incombustible, and it has the property of extinguishing flame in a very remarkable degree. Further, a very small proportion of carbonic acid in coal gas lowers the illuminating power of the coal-gas flame to a great extent. It is estimated that the presence of 1 per cent of carbonic acid in coal gas will diminish the illuminating power of the flame by 5 per cent. Now, this is a very curious observation, and requires some further explanation, which I think the following circumstances may afford:—Carbonic acid gas at a high temperature undergoes decomposition. In the interior of any flame, carbonic acid ceases to be carbonic acid; it is decomposed into carbonic oxide and oxygen, so that in this way 2 per cent of carbonic acid gas is equivalent to 1 per cent of oxygen—or it may be said that 2 per cent of carbonic acid is equivalent to 5 per cent of air—and you know that an admixture of 5 per cent of air will lower the illuminating power of gas very much. In this case, a combustion takes place partially in the interior of the flame, instead of at the surface only; and by this interior combustion the luminosity of the flame is interfered with, in accordance with well-known principles. In order to obtain the maximum of luminosity, then, the admixture of oxygen in the form of air or of carbonic acid with the coal gas should be as little as possible. Where coal gas issues under a strong pressure, it gets mixed up with air to such an extent that the flame is scarcely more luminous than that of a Bunsen burner; and, from the decomposition of carbonic acid gas into carbonic oxide and oxygen, the carbonic acid contained in coal gas interferes with the luminosity of the flame in the same way as would an admixture of air.

Carbonic acid may be further considered, not only as a constituent of coal gas, but also as a product of its combustion. That it is produced by the combustion of coal gas we may readily ascertain. If we pour a little lime water into a flask within which a jet of coal gas has been allowed to burn for a short time, the lime becomes converted into chalk, by its absorption of the produced carbonic acid, and we get at once a milky precipitate, as you perceive. But carbonic acid gas is produced not merely by combustion, but also by respiration. If I breathe into this bottle, already containing a little lime water, you see that I get at once a deposit of chalk or carbonate of calcium, just as in the last experiment of the burning gas-jet. Here a point of interest obviously arises in the consideration of the relative proportions of carbonic acid discharged into the atmosphere by the combustion of gas and the respiration of individuals. Time will not allow me to enter upon statistical details, but, speaking roughly, I may say that the air expired from the lungs contains between 3 and 4 per cent of carbonic acid, and it is calculated that one man in an hour produces about as much carbonic acid gas as a burner consuming 6 feet of coal gas, or as two burners consuming 3 feet each. So that when it is objected that any two burners in a room are producing so much carbonic acid as to affect the atmosphere injuriously, you may turn out your neighbour or turn out the gas with equal relief, seeing that he contributes quite as much carbonic acid gas as the couple of burners. Now, the ordinary proportion of carbonic acid gas in the atmosphere is under a half part in a thousand—it is about ·04 per cent. The maximum amount that has been found in the gallery of a crowded theatre, for instance, where it may be assumed that the atmosphere is defiled to its utmost possible extent both by the combustion of gas and the respiration of individuals—each individual contributing as much as is produced by 6 feet of gas—has always fallen short of half a per cent, the highest determination made by Dr. Roscoe amounting to ·32. Apparently, when the carbonic acid begins to accumulate to this extent, ventilation takes place through crevices and porous walls (for walls are freely porous to the minute particles of gases) whereby the proportion of carbonic acid is kept down, and, as I have just said, it has never been known to reach one-half per cent.

Now this observation has a very important bearing upon some other facts, to which I will refer in a minute or two; but there is, first, one other remark I have to make with regard to carbonic acid gas. It is a liquefiable gas. Under exposure to high pressure and low temperature it is converted into a transparent liquid; and, in its liquid state, it presents a most remarkable resemblance in its properties to that terror of gas managers, disulphide of carbon. Liquefied carbonic acid gas (CO_2) and disulphide of carbon (CS_2) are both of them heavier than and immiscible with water, but miscible with alcohol and ether; and they are both of them excellent solvents for fats, resins, india-rubber, &c. Further, in considering the properties of disulphide of carbon, we shall find that it acts as an anhydrous acid, combining directly with bases to form definite salts, strictly comparable with the ordinary carbonates produced by the direct combination of carbonic acid with bases.

(To be continued.)

Dr. Gustav Tschermak has read before the Imperial Geological Institute a very complete account of the gold mines of Transylvania. It appears that the precious metal is found disseminated in almost imperceptible particles in the trachytic rocks in the environs of Falathna and D'Abrud Banya, where it is still worked by the most primitive methods. There are 300 families or partnerships, consisting each of three individuals, or thereabouts. A thousand quintals of the rock yield about 8,500 grains of pale yellow gold, which contain a little silver. The rolled *débris* of the crystalline rocks found in the valley of l'Aranyos is carefully washed, and yields about half an ounce of gold to 31,000 quintals of stuff. This gold is of a deeper colour and contains less silver. They also find gold in a peculiar freestone *(Carpathiques bocardes)*, which is of a pale colour, like that found in the trachytes. The gold mines of Transylvania have been worked from the earliest historic times, yet they still furnish above 2,000 lbs. avoirdupois annually.—*English Mechanic.*

ON NITROGLUCOSE.

By M. CAREY LEA.

As nitroglucose has been much less studied than its congeneric nitro-substitution compounds, pyroxylin, xyloidin, and nitroglycerin, a few words on its preparation and properties may not be uninteresting.

The substitution does not take place in sugar with quite the same facility as with cellulose; the acids need to be stronger, and the temperature lower. The sugar, moreover, appears at first to dissolve, and then to separate out again in the form of a greyish paste, which, when thrown into water and freed from the adhering acid, becomes nearly white.

An attempt to prepare nitroglucose by the use of nitre and sulphuric acid, which succeeds so well and so easily in the case of cellulose, failed almost wholly with sugar. Not more than two or three per cent of the weight of the sugar was obtained.

With sulphuric and strong nitric acids, allowed to cool thoroughly after mixing, the reaction takes place easily, and a considerable quantity of nitroglucose is obtained. The nitric acid should be as strong as possible, and as the acid of the requisite strength is not easily obtained commercially, I have found an advantage in using in part the fuming sulphuric acid. Two fluid ounces of fuming sulphuric acid, two of common sulphuric, two of strong nitric acid, as near to 1·5 sp. gr. as can be obtained, give good results. The sugar is stirred in, in the form of powder, to a thin paste. The stirring is kept up, and as fast as the nitroglucose separates in doughy masses, it is removed with a spatula and thrown into cold water. A further addition of sugar will give more nitroglucose, but considerably less in proportion than the first addition. As soon as possible, the nitroglucose is to be kneaded up with cold water, to get the acid out. In one case, when this was neglected for ten or fifteen minutes, the nitroglucose passed to a greenish colour, and apparently was undergoing a commencing decomposition.

The removal of the adhering acid is much more difficult than in the case of pyroxylin, and is an extremely disagreeable operation. The acid pervades the whole of the doughy mass so fully, that the fingers are stained and burned by it, nor can the whole of the acid be removed satisfactorily in this way. The best means I found was to dissolve the crude nitroglucose in a mixture of alcohol and ether, and then to pour this into a large quantity of cold water with constant stirring, and violent agitation afterward. The method is not altogether satisfactory, and seems to be attended with some loss of material, though why, it is not easy to see.

Prepared in this way, nitroglucose is a white lustrous body, which may either assume the doughy amorphous condition or the crystalline, and passes from one to the other with extreme ease. When first formed by the mixed acids, it always has the doughy form. That which I obtained by the use of nitric and sulphuric acid, was crystalline from the first. When precipitated by water from its solution in alcohol and ether, it is doughy and almost liquid, and remains so for a long time, if there is any considerable quantity of it.

The best mode of preserving it appears to be under water. By standing thus it gradually hardens, and passes sometimes to a somewhat hard amorphous mass, and sometimes to a granular crystalline state. It appears to be wholly insoluble in water. A few minute grains of the crystalline form diffused through 15 or 20 ounces of water, did not dissolve after many hours standing. In a mixture of alcohol and ether it dissolves as easily as sugar in water, and in such quantity as to make the liquid syrupy.

Its detonating properties are but slight. If it be well dried and a match be applied, it deflagrates with a feeble flash.

It has been stated by Dr. V. Monckhoven that when dissolved in alcohol and kept some time in a warm place, it undergoes decomposition, as evidenced by the fact that the solution then gives an abundant precipitate with nitrate of silver, which at first it did not do. An experiment made in this direction did not give the result thus indicated. A solution of nitroglucose in alcohol, containing about 40 grains to the ounce, was placed in a stoppered vial, and was kept in the sand bath at a temperature of about blood heat for nearly a month. But neither it nor a fresh solution gave a precipitate with alcoholic solution of nitrate of silver. It would seem from this that certain conditions of temperature or otherwise are necessary, in order that this decomposition should take place.—*American Journal of Science*, *May*, 1868.

ON SCIENCE TEACHING IN SCHOOLS.

By GEORGE FARRER RODWELL, F.C.S.

The subject of "Science Teaching in Schools" is at the present time receiving a good deal of attention, and it is undoubtedly one of the most prominent educational questions of the day. The ordinary school curriculum, although sanctioned by the usage of centuries, is about to undergo a profound change, indeed some of our public schools have already admitted innovations which are the horror of the more conservative masters. The chief feature of the contemplated change is the introduction of the study of at least two modern languages and of natural science into the usual school course. Hitherto, science, if taught at all, has been considered a supplementary subject, like music or Italian, to be taken up or not at the option of the pupil; as a necessary consequence of this no special portion of the school hours has been allotted to science teaching, and none of the ordinary studies have been omitted or abated. If the study of science is thus added to the usual tale of school work, it can be no wonder that apathy is so often exhibited in regard to it, and that boys are unwilling to increase their studies even by one which possesses the charm of novelty, and which appears at first sight to combine amusement with study.

The mode of teaching natural science differs considerably from that which is adopted with the subjects of the usual school course, because in the study of science it is possible to materially aid the subjective action of the intellect by objective means, while this is impossible in regard to classics, history, composition, &c. Natural science is capable of being taught in three different ways: (α) Individual study (by means of text books) directed by a competent master; (β) Collective study in the form of experimental lectures, supplemented by the writing of themes, and by examinations, both *viva voce* and written; (γ) Practical work in a physical or chemical laboratory. Now it is undoubted that the best scientific culture can only be acquired by the simultaneous practice of these three modes of study, yet in discussing science teaching, lectures are frequently regarded as the only form of instruction possible in a school. No idea can be more erroneous than this; a sound knowledge of the least complex of the sciences cannot be efficiently acquired by simple attendance at lectures. Under any circumstances the study of the text-book should accompany the lecture-study, and if possible the student should have a certain amount of practical laboratory work. Natural science possesses an advantage over the subjects of the usual school course, in that it is based upon tentative action. The different parts of a connected process of scientific thought can, to a greater or lesser extent, be demonstrated by direct experiment, by which means a readiness of grasp and a facility of comprehension in this particular direction, is conferred upon the intellect, and it is rarely required to bridge over large unexplored tracts in passing from one generalisation to another. Each step in our rise to a generalisation should be an experiment, or a fact indubitably proved, and it is most essential that we ascertain the stability of the succeeding step before we quit that upon which we stand.

The amount of experimental illustration possible to different branches of science varies considerably. Pure mathematics is incapable of illustration, mixed mathematics sometimes admits of black-board illustration, but it is in applied mathematics that we perceive the dawn of experimental illustration proper; then follow the more mathematical of the physical sciences. In the time of Newton optics would have come in here, but since the application of the electric lamp to optical experiments we must class optics with those sciences which admit of the most extensive illustrations,—that is with heat, electricity, acoustics, &c. Chemistry stands alone; from its very origin it has been based upon tentative actions. The alchemists and old chemists expended but little mind work upon their labours; they had no problems to solve, or theories to elucidate, and their work was essentially tentative, hence the early rise and rapid development of an extensive experimental system in chemistry. Geber, who lived in the eighth century, could have given (and probably did give) a well illustrated course of chemical lectures; he could not, indeed, have produced acetylene by synthesis, or have illustrated the properties of zinc-ethyl, but he could have shown many of the processes which are in daily use among chemists,—distillation, sublimation, calcination, &c., and the preparation of many familiar acids and salts. It is impossible to read his treatise "*De Summa Perfectioni*," without feeling convinced that chemistry was by no means new-born a thousand years ago, indeed there is strong evidence to show that nitric acid was known to the Egyptians at least two thousand years before the time of Geber.

The first great impetus was given to the experimental illustration of physical science, (as distinguished from chemistry), by the members of the Accademia del Cimento, whose elegant and refined experiments have not yet ceased to be quoted in text-books and practised in lectures. The perusal of the "*Saggi di Naturali fatte nell' Accademia del Cimento*," cannot fail to strike us with the ingenuity in contrivance, the skill in construction, and above all the delicacy of manipulation of the Florentine Academicians. Before the foundation of the Academy in 1657, physical experiments were extremely rough and clumsy, as may be seen by reference to the "*Historia Macrocosmi*," of Robert Fludd, or to the "*Novum Organum*." Pascal, Hooke, and Boyle did much to further the means of physical illustrations. During the last years of the seventeenth century a well illustrated course of lectures on pneumatics might have been given, but I do not think that this could have been done in regard to any other branch of science. A few lectures sparsely illustrated might have been given on dynamics, hydrostatics, and hydrodynamics. In 1730 Francis Hauksbee, a philosophical instrument maker, living in Crane Court, Fleet Street, supplied the apparatus, and acted as demonstrator of a course of twenty-six lectures on natural science; it is instructive to note the nature and division of the subject matter. The syllabus which consisted of twenty pages of text, and twenty full page plates, served at the same time as a catalogue of Hauksbee's apparatus; it is entitled, "A course of mechanical, optical, hydrostatical, and pneumatical experiments, to be performed by Francis Hauksbee, and the explanatory lectures read by William Whiston, M.A."

The subject matter was divided as follows:—

Mechanics	seven lectures.
Optics	five ,,
Hydrostatics	three ,,
Pneumatics	eleven ,,

The lectures appear to have been well illustrated; the terms were two and a half guineas for the course. I am inclined to imagine that this was the most extensive and best illustrated connected course of lectures which, up to this time, had been delivered in England.

In 1720 the first comprehensive text-book of physics was published. It is entitled, "*Physices Elementa Mathematica Experimenta Confirmata*," and it was the work of the celebrated S'Gravesande.[*] The third edition of this work (published in 1742) consists of two quarto volumes, containing no less than 127 full page plates, and 1,073 of letter-press. Much of the apparatus described is in use in the present day, and the plates may always be consulted with advantage. The work contains a complete account of the physical science of the period, exact mathematical treatment being introduced whenever it is possible. The sciences treated of are statics, dynamics, hydrostatics, hydrodynamics, pneumatics, optics, and astronomy. Heat, acoustics, magnetism, and electricity are very briefly alluded to, for at this time none of these subjects (perhaps excepting magnetism) had arrived at the dignity of a science. Among the intimate friends of S'Gravesande was Peter Van Musschenbroek, who founded a chair of physics at Leyden, and it is to a great extent to these two men that Europe owes the introduction of the Newtonian physics into her universities and schools. Musschenbroek was Professor in the University of Utrecht from 1723 till 1735, during which he translated the "*Saggi di Naturali esperienze fatte nell' Accademia del Cimento*" into Latin, and at the same time he added a number of experiments of his own, chiefly in the form of notes to supplement the account of the Florentine experiments. The translation is prefaced by an oration, "*De Methodo Instituendi Experimenta Physica*," which Musschenbroek delivered before the University in 1730, and which contains much valuable and suggestive matter. A singularly elegant passage (albeit it is couched in the florid Latinity of the period), occurs in the opening address of this oration. Beginning with "Amplissimi Nobilissimi," he addresses himself to the professors of the University, the clergy, the doctors in all arts and sciences, and the citizens; then to the students he says:—"Tu denique lectissima studiosæ juventutis corona, spes patriæ, parentum gaudium, noster amor."

In connection with the teaching of physical science let us not forget John Christopher Sturm,[†] who was thirty-five years Professor in the University of Altorff, "*Ubi*," says his biographer, "*mathesin et physicam summa cum laude et applausu docuit.*" He did much to cultivate a taste for experimental science in Europe, and to prepare the way for the labours of S'Gravesande, Musschenbroek, and Boerhaave, who like him were zealous propagandists. Sturm must ever be remembered with gratitude as one of the first professors in Europe, "*Physieam scientiam juxta cum mathematicis publice docere.*"

Shortly after the publication of S'Gravesande's physics Boerhaave (who was also a Leyden professor) published his "*Elementa Chemiæ quæ anniversario labore docuit in publicis privatisque scholis.*" This work appeared in 1732 in two quarto volumes, and it did for chemistry that which S'Gravesande had done for physics; it was the first comprehensive work on the subject, and served for many years as the chemical text-book of Europe.

The University of Leyden must ever be remembered with respect by the student of science. If it were alone for its association with that great triumvirate—S'Gravesande, Musschenbroek, Boerhaave,—it would be entitled to our grateful memories. From it emanated the two first text-books of experimental science; the discoveries of its professors pervade our treatises; its students, who flocked to it from all parts of Europe, carried back to their native countries the love for experimental science with which they were there smitten; in it science has always found a home, and a loving, watchful, indulgent parent.

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[*] Born 1688; made Professor of Astronomy and Mathematics in the University of Leyden in 1717; died 1742.

[†] Born 1635; died at Altorff (in Franconia) in 1703.

For many years after the time of S'Gravesande natural science found but little favour in our own universities, and was altogether untaught in our schools. A great impetus was given to its study by the discoveries of oxygen and of chlorine, the improvements added to the air-pump and electrical machine, the discovery of voltaic electricity, and the brilliant application of it as a decomposing agent by Sir Humphry Davy. The Royal Institution lectures have done much to diffuse a love for experimental science. It is only during the last thirty years that science has asserted itself as an educational engine in this country; it has year by year been taught more fully in the universities and medical schools, and the time has at length arrived when by general consent it is to be diffused throughout the length and breadth of the land by its introduction into schools. It is now to form a part of a liberal education; some would make it the *basis* of a liberal education, but they err greatly not knowing the precise nature of the study. Science is too exact and rigid to engage the attention of a young pliant mind with all knowledge before it. It is a study which does not educate the intellect in matters of taste, or style, or literary elegance. Holmes has well said, "Scientific knowledge, even in the most modest persons, has mingled with a something which partakes of insolence. Absolute peremptory facts are bullies, and those who keep company with them are apt to get a bullying habit of mind;—not of manners perhaps. . . . . Take the man for instance who deals in the mathematical sciences. There is no elasticity in a mathematical fact; if you bring up against it, it never yields a hair's breadth; everything must go to pieces that comes in collision with it . . . Every probability—and most of our common working beliefs are probabilities—is provided with buffers at both ends, which break the force of opposite opinions clashing against it; but scientific certainty has no spring in it, no courtesy, no possibility of yielding. All this must react on the minds which handle these forms of truth." Fully endorsing every word in the above extract, I say that science can never be the basis of a liberal education; neither should it be taught in any but a highly experimental non-theoretical form to the lower classes of a school. But when the student is more advanced, when his mode of thought has been methodised and syncretised in certain directions, there can be no doubt that the study of science is most efficacious as a producer of exactness of thought and accuracy of perception, and of keen observant habits of mind.

It being admitted that the study of natural science in schools is desirable, the next question which presents itself is how it may be most efficaciously introduced. I do not think that it would be wise to add this new study without at the same time diminishing the time devoted to some of the present studies. We must feel our way: a portion of two days in each week is amply sufficient for science teaching, and such lessons may perhaps most advantageously replace a portion of the mathematical training. Natural science and mathematics have so many points of contact that they may be assimilated as much as possible. Francis Bacon has well said, "*Optime autem cedit inquisitio naturalis, quando physico terminatur in mathematico.*" The work of science teaching would perhaps be best accomplished by a resident master whose labours should be supplemented by one or more of the mathematical masters. I strongly dissent from the opinion expressed by Mr. Oscar Browning in an able and suggestive article as to the mode of teaching[*]:—"A system of itinerant lectures," writes Mr. Browning, "to great schools, by great men, would be a powerful educational engine. . . . The sight and voice of great discoverers may fertilise latent germs of kindred genius." Now I venture to assert that such a method of science teaching would be of far too excitable a character to be productive of serious and calm study. If an exciting cause is necessary to induce the study, it would often happen that the latter would be discarded when the former disappeared. Schoolboys would become so *blasé* that eloquent Professor A—— would have an audience of five hundred while the less eloquent but equally learned Mr. B—— would have to content himself with a score, just as the Parisians flock to hear Père Hyacinthe while they leave the godly Curé of Nôtre Dame de Lorette with an empty church. Unless science recommends itself by its own beauty, I think it unwise to tempt boys by such factitious means. The study must be taken up willingly, and the mind of the pupil must be more or less assimilable with the mode of thought required, or the teaching (especially such excitable teaching) is useless. It appears to me that the very principle is wrong. Many a man who would fail to distinguish between the tenets of Anselm and John Huss would devote himself to doctrinal divinity if the Archbishop of York would be his teacher; or again the most unmusical individual would willingly give up every moment of his spare time to music if Rossini would be his master, and La Lucca would sing to him, and Joachim be his accompanyist. Nay, I will go a step farther: are there not many to whom the very names of Poinsot, Fermat, and Laplace are all unknown, who would devote themselves to curves fulfilling the equation—

$$\frac{d_2\phi}{dx_2} + \frac{d_2\phi}{dy_2} = 0$$

if Sylvester or M. de la Goupillière would instruct them? But in each of these instances the action passes off from love of the subject to admiration of the teacher. Unless the student has some special subjective affinity with that which he studies, he can never excel in it, never thoroughly master it. If science is to be introduced into our schools, it must be studied calmly, soberly—ay, reverently, and without factitious advantages, for she is a modest maiden in a russet mantle, not a gaily dressed woman of the world. "The sight and voice of great discoverers 'might indeed' fertilise latent germs of kindred genius," but I think if the germs of genius were already in the student they would assert themselves without such inducements. There is certainly an attractiveness in peculiarity of diction, unusual phraseology in style, mode of expression, even in voice and action; but what said the older rhetoricians of some of these practices? Gorgias, the Sophist, did indeed advocate them, but we may willingly allow the use of a meretricious rhetoric to the man who made it his principal object to demonstrate that nothing exists, and that nothing can be known.

Many will enquire the object of teaching natural science in schools. I say it is to be regarded as a particular kind of mental training, as the inducer of an exact and discriminative mode of thought which attains its highest development in the pure mathematics, and which just dawns in the classificatory sciences, such as botany, &c. I do not think that the classificatory sciences can be taught with advantage except to very young boys. In pure mathematics each step is gained by intellectual action, while in the classificatory sciences memory is more important than intellectual action. Experimental science partakes of both, but it is happily placed nearer to the purely mathematical than to the classificatory sciences. The object of science teaching has been variously defined. "Different branches of science," says Mr. Browning, "are admirably suited to be applied as alteratives to the jaded mind, and to excite the appetite for knowledge which may have been dulled by application to the regular studies." I must again protest against this view of the object of science teaching. Surely natural science is a study too noble to be allotted to "jaded minds," to refuse mental action—too full of dignity to be used as a spice to excite the literary appetite in a direction remote from itself. Science rightly demands of her followers clear, bright, fresh intellects, unfettered in their action, and devoted to her interests, and if the study is to be introduced into our system of education it is only under these conditions that it will flourish.

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[*] *Vide* Chemical News, No. 442.

One word in conclusion on the subject of education in general. It appears to be the fashion just now to abuse some of our high class schools and our whole system of education. Whenever an educational debate takes place in the House of Commons we may be sure that some member will bring in the fact that when he was at Eton, or Winchester, or elsewhere, he learnt "*nothing*," and on that account he condemns the entire school system. But side by side with him in the school were there not men who in after life shone at the Universities, at the Bar, in public life? *They* evidently learned something, albeit they were placed under the same circumstances as himself, at least there was the opportunity of learning, and the fact of learning nothing would seem to tell rather against the individual than against the school or the system. But even if he learnt nothing of ordinary book work, he learnt much that forms part of a liberal education and which is essential to him as a man, but for which he gives the school no credit:—a gentlemanly tone and character, a facility of intercourse with his fellows, a modus of routine, a manly masterful spirit, a sense of honour, a knowledge that he must hold his own, and fight his own way in the world, and a certain *esprit de corps* which remains with him through life. It is too trite to remark that a school symbolises and typifies the great world of human beings without. The world is a macrocosm, the school is a microcosm. In the latter there are the same struggles against opposing causes, the same oppression to be resisted, and wrong to be avoided as in the former; the same striving to attain, the same right principal to be maintained, and obedience and respect to be rendered; the same exhibition of passions, feelings, hopes, aspirations, the same bestowal of brotherly love; while pervading all, sanctifying all, binding all together into one harmonious whole is the great maxim, "Fear God, honour the king." Then there is that veneration of all that is ancient, that intense admiration for the patriotism and valour which in former ages ennobled dynasties, and raised mere specks upon the earth's surface into powerful states governing half the world; in our schools we are surrounded by these influences, and we imbibe them and carry them to our graves. Is it nothing to learn these things? The different portions of educational work—classics, composition, history, natural science, &c.,—are but separate tools which are used to perfect the form of the intellect. At first it is often of an ungainly form, rugged, and misshapen; the joint action of many tools can alone bring it to a perfect form.

I say then we must not judge our educational system by the actual *knowledge*, in the ordinary acceptation of the word, which is acquired at school. The formation of an elegant, appreciative, and discriminative taste must ever be the main object of a liberal education; hence it is that I deprecate the introduction of *applied* science at least into our public school curriculum. If science is taught at all it behoves us to teach the purest form of it. I see nothing elevating or improving to the intellect of a boy in the knowledge of the modes of utilising tar liquor, or of dyeing calico. Science has a higher object than this to perform in our educational system, as a mind former, as the completer of a certain phase of brain action, and the cultivator of scrutiny, of accuracy, of connected thought, and legitimate generalisation. If there be nought that is elevating in applied science, truly there is much in pure science. Under her guidance we may trace a force throughout the universe, and note the eternal resolvability of its form: we may visualise the sea of ether with its waves ever dashing upon us, now gladdening all things in the form of light, anon vivifying the universe in the form of genial heat.

FOREIGN SCIENCE.

PARIS, JULY 22, 1868.

Influence of the condensation of the vapour of water in experiments on the absorbent power of gases.—Persulphide of hydrogen.—ACADEMY OF SCIENCES. Researches on electrolysis.—Laws of induction.—Secondary currents.—Preparation of crystallised sulphides of iron and of manganese.—Researches on the dissociation of certain ammoniacal chlorides.

AT the same time, in 1861, Professor Tyndall in London, and M. Magnus at Berlin, published their experiments on the transmission of heat through different gases. These entirely independent experiments, having nothing in common in the *modus operandi*, led to results in part concordant, in part discordant. By this dual research it was clearly established that the absorbent power of different gases is extremely different. But with regard to the absorbent power of the vapour of water, Professor Tyndall asserts it to be very considerable, while M. Magnus asserts it to be insignificant. When the vapour is in the state of mist, both agree in recognising that the vapour absorbs a considerable part of the heat which it receives, but when the vapour is transparent, when it presents itself as humid air, the divergence of opinion is as great as possible. In his memoir upon the production of dew, M. Magnus has demonstrated that the emissive power of dry air is equal to that of a moist air, whence results the equality of their absorbent powers. Since then M. Wild, of Berne, has made experiments which plainly confirm those of the English physicist. M. Magnus has repeated M. Wild's experiments, and while proving their perfect accuracy, he has discovered a source of error which is a complete explanation of their results. In these experiments, the thermoelectric pile is placed equi-distant from two cubes of hot water, from which it is separated by brass tubes. The diaphragms enable the two currents of heat to be regulated, so that the two faces of the pile are equally heated, or the galvanometer rests at zero. This equilibrium, being obtained when the tubes are filled with dry air, should remain when moist air is substituted; but this is not the case. M. Magnus has sought the cause; this he finds in the condensation of the vapour against the internal surface of the tubes. It is a great mistake to suppose that the heat undergoes no modification in passing through the tube. When the interior is polished an infinite number of reflections are produced, and the tube sends to the pile rays which would not reach there if they were absorbed. In consequence of these multiple reflections, the pile may receive six times as much heat as if the tube did not exist. Everything which will diminish the reflecting power of the sides of the tube, and everything which will augment their absorbent power, will contribute to diminish the heat which falls upon the pile. Then this effect of the condensation of the vapour of water takes place when the tube is full of moist air. The minute layer of water which is deposited on the internal surface can have but little influence when this surface is tarnished, while it will have an enormous influence in a polished tube, an excellent absorbent being superposed to a reflecting surface. What happens further? The galvanometer being at zero with the tubes full of dry air, if moist air be introduced into the one of them, the equilibrium will subsist if the tube is blackened, while it will be immediately destroyed if the tube is internally polished. The heat will appear to be absorbed by this tube; and it is in fact, but by the bed of moisture which covers the sides, and not by the moist air which fills the tube. The effect is particularly marked when the tube is cooler than the air, but it is observable also when the tube is notably warmer, proving that the vapour condenses on the sides, even when the space is not saturated. The vapour of alcohol behaves like water and with still greater energy; the experiment in blackened tubes proves that it exerts a sufficiently notable absorption.

Dr. Hofmann has made some experiments upon the persulphide of hydrogen. When a cold saturated solution of strychnine in strong alcohol is mixed with an alcoholic solution of sulphide of ammonium containing an excess of sulphur, brilliant crystalline flakes soon make their appearance, and twelve hours later the sides of the vessel are covered with fine needles of an orange colour, often some centimetres in length. To obtain them in a state of perfect purity, it suffices, after decanting the mother liquor, to wash with cold alcohol. These crystals are completely insoluble in water, alcohol, ether, and sulphide of carbon, in fact no solvent from which they may be recrystallised has been found. An analysis of this compound has led to the following formula:—$C_{21}H_{24}N_2O_2S_3 = C_{21}H_{22}N_2O_2,H_2S_3$. These crystals would then be a combination of a molecule of strychnine with a molecule of a persulphide of hydrogen, of which the composition would be expressed by the formula H_2S_3. The crystals become decolourised upon the addition of a few drops of concentrated sulphuric acid; sulphate of strychnine is formed which dissolves, while persulphide of hydrogen is separated under the form of a colourless and transparent oil. The drops of oil may be preserved for some time, but they are not long in decomposing into hydrosulphuric acid and sulphur. M. Hofmann says this combination of strychnine and persulphide of hydrogen, which can be preserved for months, leaves no doubt as to the existence of a persulphide of hydrogen (H_2S_3), which would thus be a sesquisulphide; other persulphides may, however, exist. The combination with strychnine is, as already mentioned, characterised by great insolubility; it remains to be seen whether this property can be utilised in the isolation of the alkaloid.

The following memoirs were brought before the Academy at the meeting on the 22nd of June:—"Researches on Electrolysis," by M. Favre; "On the Laws of Induction," by MM. Jamin and Roger; "On Secondary Currents and their Applications," by M. Planté; "On the Preparation of Sulphides of Iron and of Manganese," by M. Sidot; "Researches on the Dissociation of certain Ammoniacal Chlorides;" "Note on the Purification of Sulphide of Carbon," by M. Commaille.

In a former note, M. Sidot showed how certain natural sulphides could be reproduced with the forms they present in nature; with the processes then used he has essayed the preparation of other sulphides, in particular those of iron and manganese. With iron two sulphides were obtained, the protosulphide crystallised, and the magnetic sulphide possessed of magnetic polarity. To obtain this result, a current of dry sulphuretted hydrogen is made to pass over artificially prepared magnetic oxide of iron, heated to bright redness. At the commencement of the operation, aqueous vapour and sulphurous acid are disengaged, and at the end of about two hours, the whole of the oxide is transformed into sulphide, in a state of perfect fusion. Upon raising the temperature then, a considerable evolution of sulphur vapours is noticed, indicating that the sulphide formed becomes decomposed under these conditions. After cooling, the porcelain tube which has served for the operation is broken and the cold part will be found lined with fine crystals of hexagonal sulphide of iron. The crystals of hexagonal sulphide present, like those of blende, a variable colour from black to citron yellow. M. Friedel, who has examined them, has found their form to be that of the hexagonal prism, modified by the tangent prism; unfortunately these modifications were not capable of measurement. These crystals present clearly the characters of the protosulphides, with which they are isomorphous; this sulphide is not at all magnetic. Its formation is easily explained, observing that the magnetic oxide of iron gives rise to the corresponding sulphide Fe_3S_4, and this sulphide at a very high temperature yields sulphur which volatilises, and protosulphide of iron, FeS, which sublimes and crystallises in hexagonal prisms on the cooler portions of the tube. The residue in the porcelain tube not sublimed is magnetic sulphide of iron, Fe_3S_4; this sulphide is not only magnetic, but possessed of magnetic polarity. The crystallised protosulphide of manganese can be prepared in passing a current of dry sulphuretted hydrogen over sulphide of manganese. By this process greenish yellow hexagonal prisms have been obtained; with polarised light they behave like hexagonal blende; at the same time small lamellar plates, in the form of crosses or squares, are produced, shown very clearly in the specimens placed under the eyes of the Academy.

Various investigators have shown that a great number of metallic chlorides can absorb dry ammonia gas and form compounds; these compounds are usually capable of ceding the gas they have absorbed upon exposure to the atmosphere, or better when slightly heated. These are some of M. Isambert's results. Chloride of silver placed in a current of ammonia gas absorbs an amount varying with the temperature to form two compounds: (1) above 20° it yields the compounds already known to exist, $2AgCl,3NH_3$; (2), between zero and 15°, a compound not yet signalised is formed, $AgCl,3NH_3$. The study of the tension of the ammonia gas disengaged from either of these combinations, shows that the pressure remains constant when the temperature remains constant; when the temperature is raised the tension of the ammonia increases. Chloride of calcium absorbs ammonia gas in very large quantity; besides the two compounds already known, M. Isambert has obtained one expressed by the formula $CaCl,4NH_3$. This compound, as well as the one with two molecules of ammonia, has a tension of dissociation, constant for the same temperature. Iodide of calcium forms a compound, $CaI,3NH_3$, which follows the same laws as the bodies previously described. Chloride of zinc and chloride of magnesium furnished two new compounds, $ZnCl,3NH_3$, and $MgCl,3NH_3$. These bodies behave exactly as those already described. Some experiments were also made with bodies which absorb ammonia without forming combinations, bodies of the nature of carbon. Here the tension of the ammonia gas disengaged was found to be no longer constant with the temperature constant; it diminished rapidly when the quantity of gas contained in the apparatus was diminished.

MISCELLANEOUS.

Department of Science and Art.—In our number for May 3rd, 1867, we published a letter from a correspondent announcing that the Council of Education had offered to make payments to science teachers to enable them to visit the Paris Exhibition, and for any reports or useful suggestions which they might make (in respect to their duties or teaching) derived from the study of the Exhibition, and offered further sums of £20, £15, and £10 for the best of such reports referring to instruction in science. We now learn that on examining the reports sent in, it appears that the *best* do not fulfil the conditions of the minute. The Lords of the Science and Art Department have therefore made special grants as follows, viz., to Mr. Shore of Burnley, and Mr. E. A. Davidson of London, £15 each; and to Mr. Mayer of Glasgow, Dr. Wilson of Nottingham, Rev. B. W. Gibsone of London, and Mr. Bolam of Leith, £10 each. One section of Mr. Gibsone's prize report has already appeared in the Chemical News.

The Atmosphere of the Metropolitan Railway.—The attention of whatever authorities may exist for the control and direction of railways must be earnestly invoked to the frightful state of the atmosphere—we beg pardon for misusing the term—in the Metropolitan Railway tunnels. Several persons died in these shamefully neglected passages during last summer, and, if one is to look at the present state of the line, they died in vain. Something was done or said to have been done, and scientific witnesses of great distinction distinguished themselves by re-assuring the public mind as to the salubrity of the tunnels. The company produced their own servants in such blooming states of health that some folks were expected to reside permanently in the carriages "for the benefit of the air." Still, however, in the worst part of the railway, *i.e.* from King's Cross to Baker Street, the heat is often so great that perspiration streams over travellers' faces, and the effect of the want of ventilation is so painful that scores drag themselves faintly up the steps at the stations. If there is no reason why the atmosphere of a coal-pit should be maintained in London, the tunnels ought to be properly ventilated. Two or three shafts placed after the manner of mines with furnaces at their feet would serve the purpose. It is not needful to place such shafts immediately over the arch and in the middle of the highway, but some wisely-selected spot would suit on that "surplus property," which is said to be worth a million, and to be in the hands of the company. We do not assert that the company actually possesses so vast an estate as this sum of a million would imply, but there can be no doubt,—1, that it can afford to ventilate the line; 2, that if Parliamentary authority has enabled it by *compulsory* purchase to obtain so enormous an estate the sooner that matter is inquired into the better.—*Athenæum.*

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Bulletin de l'Académie Imperiale des Sciences de St. Petersbourg.
January 13th, 1868.

E. Borsczow, "On the Action of Nitrous Oxide on Plants." Woronichin, "On the Influence of Chloride of Potassium and Chloride of Sodium on the Assimilation and Excretion of Metallic Iron by a Dog."

Comptes Rendus.
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Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

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741. J. Lewthwaite, Woburn Place, Middlesex, "Improvements in treating the material known as 'parkeseine,' and in applying it to various useful and ornamental purposes."—Petition recorded March 4, 1868.

1696. J. J. Harrop, Manchester, and W. Corbett, Clayton, near Manchester, "Improvements in the production of iron and steel from ores and from waste products containing iron, as in cases of hammer slag, forge cinder, and the residue arising from the manufacture of sulphuric acid from iron pyrites."—May 23, 1868.

1849. A. Prince, Trafalgar Square, Middlesex, "Improvements in the manufacture of metal castings."—A communication from E. L. Brown, Philadelphia, Penn, U.S.A.—June 5, 1868.

1945. C. E. Schwartz, Aske Street, Hoxton, Middlesex, "An improved mode of, and means for, obtaining crystal brocatel colours."—June 13, 1868.

1948. L. S. Thomassin, Rue d'Enghien, Paris, "Improvements in the process of, and apparatus for, producing combustible and illuminating gas."—June 15, 1868.

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1980. C. Hengst, and H. Watson, Fulham, Middlesex, "An improved mode of, and means for, manufacturing gas for lighting and heating purposes."—June 18, 1868.

2034. J. Mitchell, Bradford, Yorkshire, "Improvements in furnaces."—June, 24, 1868.

2045. E. Lever, Denton, Lancashire, "Certain improvements in the preparation or coating of woven fabrics which are to be subsequently rendered liquid proof or non-inflammable."

2048. Rev. H. Highton, M.A., Brighton, Sussex, "Improvements in the manufacture of artificial stone or slate, and in colouring the same."—June 25, 1868.

2061. L. Thomas, Leadenhall Street, London, "A new or improved apparatus to be used along shore, for the distillation of pure water from salt water or water impregnated with earthly or other matters."—June 26, 1868.

2065. P. R. Hodge, Adam Street, Adelphi, Middlesex, "Improvements in, and application of, the use of hydrocarbonaceous fluids in combination with highly attenuated or super-heated steam for the purposes of smelting, melting, reheating, and working of metals, glass, porcelain, or calcareous materials."

2067. J. Braggs, High Holborn, Middlesex, and F. Braby, Camberwell, Surrey, "Improvements in the extrication and condensation of ammonia, and in the manufacture of ammoniacal salts."

2072. W. F. Deane, Farnworth, near Bolton, Lancashire, "Improvements in obtainining oxide of manganese from a certain residual product of the manufacture of chlorine."—June 27, 1868.

2108. L. Francis, New York, U.S.A., "Improved compositions applicable to printing purposes and to the manufacture of printing materials and the production of emery cloth, artificial hones, and other polishing surfaces."

2112. J. E. Poynter, Glasgow, N.B., and T. L. Patterson, Greenock, Renfrewshire, N.B., "Improvements in obtaining or manufacturing saltpetre, iodine, and bromine."—July 2, 1868.

2134. A. Fryer, Manchester, "Improvements in the concentration and treatment of saccharine and saline solutions, and in apparatus employed therein."—July 4, 1868.

NOTICES TO PROCEED.

662. W. Weldon, Park Villa, West Hill, Highgate, Middlesex, "Improvements in the regeneration from chlorine residues of oxides of manganese suitable for use again in the manufacture of chlorine, and capable of being applied also to other purposes."—Petition recorded Feburary 27, 1868.

753. C. Schinz, Faubourg de Saverne, Strasbourg, France, "A process for the partial elimination of the nitrogen from the products of combustion, and furnaces and apparatus connected therewith."—March 4, 1868.

901. W. E. Gedge, Wellington Street, Strand, Middlesex, "Improved fuel, by the use of which the kindling of fires will be greatly facilitated."—A communication from K. N. Legendre, Passage des Petites Ecuries, Paris.—March 17, 1868.

1519. J. Norman, Glasgow, N.B., "Improvements in calcining, burning, or oxidising ores, minerals, metals, and other substances, and in reducing oxides and salts of metals and other substances, and in apparatus for these purposes."—May 9, 1868.

1839. W. Firth, Burley Wood, near Leeds. "Improvements in deodorising petroleum and other oils."—June 4, 1868.

1860. J. Dewar, M.D., "Improvements in preserving and arresting decay in certain vegetable substances for the purposes of food and manure."—June 6, 1868.

1940. K. Maltater, Pall Mall, Westminster, "An improved mixture or compound for cleaning gloves and other articles."—June 13, 1868.

NOTES AND QUERIES.

Aurine.—Printing Ink.—Noticing Dr. Adriani's remarks on rosolic acid, I have tried unsuccessfully to obtain the dry orange pigment of which he speaks. I first made a hot strong solution of carbonate of soda and saturated it with aurine cake, and then mixed slowly a strong solution of alum until the reaction ceased. I obtained, by washing the precipitate, a fine scarlet lake, but on drying slowly it became a dirty pink-tinted alumina, which becomes scarlet again by damping, and the dirty tint again when dry. The reason aurine solution is not used as red ink is because roseine cake is soluble in cold water, and gives a much brighter colour. Roseine pigments, when kept in a shady room, are almost permanent, but two days' exposure to sun and night air will thoroughly decompose the aurine colour. Nearly all black printing ink is now made of rosin oil.—R. G. B.

TO CORRESPONDENTS.

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D. Powell.—Such a book as you require is in preparation, and will shortly be published by Messrs. Longmans.

M. A. B.—"The Philosophy of Pie-juice" will not bear very close criticism. The cup we understand, but the explanation given in the following sentence has no sufficient foundation:—"No amount of sugar will sweeten fruit after it is cooked, for the sugar and the acid will not then amalgamate. When the sugar is placed in the pie before baking, as it always ought to be, the chemical action of the heat favours the effect of the sugar upon the fruit, the acidity is neutralised, and an agreeable amalgamation takes place, which can never be produced by an after addition of sugar to the pie."

W. B.—The cap evidently fitted, but our remarks about indistinct writing were addressed to another correspondent writing under the same initials. The modes of analysing quantitatively and qualitatively commercial white lead and zinc white are too simple to be worth inserting a query for them in our columns. Any modern book on analysis will give you sufficient information to enable you to devise a process best fitted to your special case.

C. Crawford.—There is no discrepancy. It is entirely an arbitrary matter whether you write the N first in ammonia, with Muller and Hofmann, or the H first, with Roscoe, Williamson, and Frankland.

Communications have been received from R. G. Bennett (with enclosure); J. Hirsch, Ph.D., Chigago (with enclosure); C. Crawford (with enclosure); W. Bees (with enclosure); Mrs. Baines (with enclosure); W. Walker; G. Andrews; M. Hodgkinson (with enclosure); Dr. Letheby; D. Powell; Major F. T. Rickard; J. Winterbottom; D. Forbes, F.R.S. (with enclosure); G. F. Rodwell (with enclosure); Ellis Jones (with enclosure); W. P. Wilson; Dr. Sheridan Muspratt; G. Wharton Simpson; W. Symes (with enclosure); A. H. Berger; Capt. Hitchins; J. Ireland, Jun.; Rev. B. W. Gibsone, M.A.; Castle and Lamb.

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Contents.—Prussiate of Potash, Oxalic Acid, Tartaric Acid, and the Tartrates of Potash, Citric Acid.

Appendix A containing additional information on Sulphur, Sulphuric Acid, Bisulphide of Carbon, Chloride of Sodium, Soda, Hydrochloric Acid, Potash, Soap, Glycerin, Aluminium and Sodium, Magnesium, Soluble Stannates, Arseniate of Soda, Silicates of Potash and Soda, Chlorate of Potash, Phosphorus, Lucifer Matches, Hyposulphite of Soda, Boracic Acid, Soluble Phosphates, Nitrate of Soda, Gunpowder, Gun-cotton, Nitroglycerine, and Prussiate of Potash.

Appendix B, containing Abstracts of Specifications of Patents relating to the materials and processes described in this and previous volumes.

Appendix C, Tables connected with these processes.

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THE CHEMICAL NEWS.

Vol. XVIII. No. 452.

NOTES ON CERTAIN ABSORPTION SPECTRA.

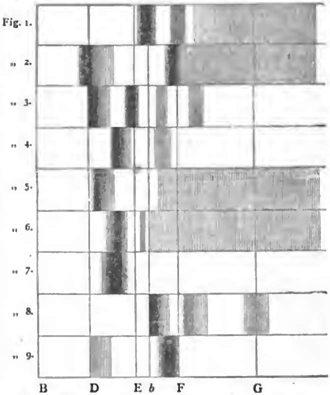
By Dr. J. EMERSON REYNOLDS,
Keeper of the Minerals and Analyst to the Royal Dublin Society, &c

The following notes are the result of some observations made during the past four years, on the manner in which certain coloured liquids act on transmitted light. This subject has already received much attention from the late Sir David Brewster, Sir W. Herschel, Dr. Gladstone, and others; but it remained for Professor Stokes, of Cambridge, to give it an unusual degree of interest by the use of the spectrum analytical method in his valuable researches on the colouring matter of blood. Still more recently Mr. Sorby has applied the spectroscope to the microscope, and thereby materially facilitated the accurate investigation of minute blood stains or other coloured spots.

In the present paper are noted cases in which I have applied the method of spectrum analysis as a sort of crucial test of the tenability of certain received opinions. I have also used it in examining the murexides and some of the coloured woods; the latter more particularly with a view to determine certain points relative to their colorific principles, and to their detection when used as adulterants in spirituous solutions. On the latter point much has been already written by others, and little can be added to that which is now well known, nevertheless I give my notes on the subject, as they were made at a time when a very small share of attention had been given to the matter.

The apparatus which I employ consists of a small pentagonal box, in one side of which is fitted a brass tube, about eight inches long; at the free end of the latter is placed a slit, adjustable by means of a screw, and at the other extremity a plano-convex lens is so arranged that the slit shall be in its principal focus. The rays of light, transmitted by the aperture, are rendered parallel by the lens, and then pass through a bisulphide of carbon prism (refracting angle = 59°), firmly fixed in the box. The spectrum of the light examined is then seen on looking through the second face of the prism. If the apparatus be pointed at a bright cloud, and the slit adjusted, the chief solar lines of Fraunhofer can be easily seen with the naked eye. When the light is made to pass through a coloured liquid contained in a test tube, and the latter placed before the slit, we most conveniently observe the characteristic absorption spectrum of the substance examined. Professor Stokes has already fully drawn attention to the distinction to be made between the production of characteristic bands in the spectrum and the mere absorption of certain colours. In some cases this is a question of dilution; in others, where no bands are developed under any circumstances, the complementary colours are then simply wanting. Thus, permanganate of potassium, when in dilute solution, gives five beautiful absorption bands in the green; but, if the liquid be concentrated, the centre of the spectrum is cut out, but no bands are observed. On the other hand, the purple colouring matter of most flowers, when in strong solution, produces almost the same degree of general absorption as the permanganate; but, if diluted, no bands are apparent, the centre of the spectrum being then merely weakened.

It is curious to remark, in examining the nature of the light transmitted by coloured solutions, the inverse relation sometimes observed to exist between the absorptive effect which a given liquid exerts on the spectrum and the intensity of its colour. We are all familiar with cases of very dilute and slightly coloured solutions, such as those of permanganate of potassium, or nitrate of didymium, which give rise to characteristic and strongly marked *bands* but cases the reverse of these are not often met with. In the colouring matter of the common blackberry, however, we find a body which, under different conditions, will exhibit either phenomenon; but it must be premised that no distinct bands are produced. If an aqueous solution of the colouring matter be examined with the spectrum apparatus, the liquid, though of a pale purplish red tint, will be found to absorb very strongly the central portion of the spectrum, commencing near D, and shading off near F; in rather dilute solutions a trace of a band may be distinguished on the confines of the least refrangible end of the dark space. With the alcoholic solution, however, the case is different; its colour is a magnificent purple, and much more intense than the aqueous decoction; but its effect on the spectrum is very much less marked, though the light actually absorbed is of nearly exactly the same degree of refrangibility as in the first instance.



Coloured Derivative of Opianic Acid.—By dehydrating opianic acid, Professor Anderson produced a colouring matter undistinguishable chemically from madder alizarin. On removing four atoms of water from the acid we get the formula of alizarin according to the best analyses, thus:—

$$\underbrace{C_{10}H_{10}O_5}_{\text{Opianic Acid.}} - 2H_2O = \underbrace{C_{10}H_6O_3}_{\text{Alizarin.}}$$

This was a case, therefore, peculiarly suitable for examination by the optical method.

Opianic acid was prepared by Matthiessen and Foster's process, *i.e.*, by the action of manganic oxide on narcotine. This base, as is well known, gives rise, when oxidised, to cotarnine and opianic acid, thus:—

$$\underbrace{C_{22}H_{23}NO_7}_{\text{Narcotine.}} + O = \underbrace{C_{12}H_{13}NO_3}_{\text{Cotarine.}} + \underbrace{C_{10}H_{10}O_5}_{\text{Opianic Acid.}}$$

The pure and dry acid was dissolved without heat in some concentrated sulphuric acid, and the solution allowed to stand. Gradually the liquid became coloured, and simultaneously bands appeared crossing the spectrum of the transmitted light. The maximum of clearness and intensity was reached after four hours' standing at the ordinary temperature, and continued for several days.

The spectrum observed is shown at Fig. 2; it is marked by a very dark band on D, sharp at its least refrangible side, but shading off into the green. Another band on F can be seen, but it is not well marked, since the rest of the spectrum is almost wholly cut off beyond this point. In addition to the bands and shading, strong red fluorescence was observed. This colouring matter likewise gives the madder tints with mordants; but these compounds do not present any characters worthy of special notice.

When the spectrum of Anderson's alizarin is compared with that of the true madder alizarin, under like conditions (see Fig. 1), it will be seen how thoroughly distinct they are in optical properties, though so nearly identical in their chemical relations.

Rufigallic Acid.—The striking parallelism in many physical and chemical properties known to exist between madder alizarin and rufigallic or parellagic acid rendered the comparison of the absorption spectra of the two bodies, under similar conditions, a matter of considerable interest.

Rufigallic acid was prepared by digesting a solution of gallic acid in five times its weight of concentrated sulphuric acid at a gentle heat for a sufficient time. The purple-red liquid was then slowly poured into a considerable quantity of cold water. A brown flocculent deposit was thus produced; this was collected, washed with boiling water, and dried. Repeated re-solution in sulphuric acid and precipitation by water rendered this pure. With alkaline carbonates and alum, dull purple liquids were obtained. By careful sublimation the powder may be made to yield beautiful orange-yellow crystals, very strongly resembling alizarin of madder prepared by a similar process. As in the latter case, a large portion of carbonaceous residue likewise remains behind.

When the light transmitted by a sufficiently dilute solution of rufigallic acid in oil of vitriol is examined with a prism, the very characteristic spectrum represented at Fig. 3 is observed. The two least refrangible bands are those most strongly marked when the sun is the source of light; while the remaining two, of higher refrangibility, are only easily observed with artificial light. It is curious to remark here, that if a very weak sulphuric solution of the rufigallic acid be heated sufficiently, the absorption bands disappear, but become again visible as the liquid cools.

The solution of the acid in carbonate of sodium is reddish brown, and simply cuts off the most refrangible portion of the spectrum, commencing at E; with ammonia a dirty purple-red liquid, which weakens that portion of the spectrum more refrangible than F. Alum gives with rufigallic acid a solution of a fine purple colour, which absorbs much light between D and F, leaving both ends of the spectrum clear. These reactions are remarkably different from those afforded by madder alizarin.

A similar series of experiments was made with the crystalline sublimate obtained from the amorphous rufigallic acid, but the results were identical with those just described; we may therefore state that rufigallic acid sublimes unchanged.

Murexides.—The uric acid and caffeine murexides are so closely allied in chemical constitution, as well as in many of their physical properties, that it appeared to be a matter of interest to compare the action of the magnificently coloured aqueous solutions of each body on transmitted light.

Uric acid murexide was prepared by the action of ammonia or a mixture of alloxan and alloxantin, and the caffeine derivative by treating amalic acid with ammonia. The prismatic analysis of the light transmitted by the aqueous solution of each did not show any marked difference in their optical properties. In both cases the spectrum was found to be much weakened in the green, but no bands were observed. On the addition of a little hydrate of potassium, the solution of uric acid murexide changed to a violet tint, but its action on the spectrum was not very perceptibly altered. A mineral acid discharged the colour from the original liquid. The solution of the caffeine compound, on treatment with hydrate of potassium, is simply weakened in colour, but it does not absorb light differently. The presence of a free acid does not diminish the intensity or alter the tint perceptibly.

It was found, in prosecuting these experiments, that when either murexide was prepared by a process different from those above-mentioned, that product exerted the same action on the spectrum, but the relations to reagents were materially altered. We therefore learn that the two murexides remarkably resemble each other in optical as well as in general characters; so that, when prepared by similar methods, they do not differ from each other in any important point more than will two samples of the same murexide, when both have been produced by different processes.

I may now mention a curious result obtained when applying the murexide test in a peculiar way to a solution known to contain pure caffeine. The liquid was acidulated with hydrochloric acid, warmed, and then a crystal of chlorate of potassium dropped in; after digesting for a sufficient time, the whole was allowed to cool, and some strong solution of ammonia carefully poured into the test-tube, so that the column of specifically lighter liquid might float on the test solution. This was then left at rest for twenty-four hours, at the end of which time the two liquids were found to have partially mingled, and produced a purple-red solution, which on prismatic examination was observed to cut off two sharp bands in the spectrum, as represented in Fig. 4. May we not infer from the results of these experiments that uric acid and caffeine are each capable of yielding several different coloured products?

Logwood.—The light transmitted by the aqueous decoction of the wood of *Hæmatoxylum Campechianum* when analysed by the prism gives the peculiar spectrum represented at Fig. 5. This shows a strongly marked absorption band but little more refrangible than the solar line D, the side next to the fixed line being sharply defined, but the second edge shades off gradually to near E. A very marked diminution of light is observed in the higher portions of the spectrum, commencing about F; the intervening green space is also somewhat obscured. With carbonate of ammonium the solution is of purple-red colour, but the band beyond D remains unchanged; a new band, however, appears, rather faintly marked, midway between *b* and F; the remaining portions of the spectrum are much less weakened than in the last case. When the solution of the colouring matter is warmed with alum, the band near D is alone apparent, the rest of the spectrum being nearly free from shade, with the exception of a slight absorption, extending from the least refrangible edge of the band to midway between C and D; this is the point from which all light is observed to be cut off in the very strong solution. These are the most striking reactions of the aqueous decoction. The alcoholic tincture of logwood is pale yellow, and simply absorbs the blue rays from about *b*, leaving the remainder of the spectrum unchanged. If to the alcoholic liquid a drop of caustic ammonia be added, a magnificent purple-red colour is produced; this solution gives the single absorption bands just beyond D very strongly marked, and leaves both ends of the spectrum perfectly clear and bright. In weak spirituous solutions of the colouring matter other chemical agents react in nearly the same way as in the aqueous decoction.

Pure colourless hæmatoxylin ($C_8H_{14}O_3$), when allowed to oxidise by contact with the air affords a solution which reacts in precisely the same way as the aqueous infusion of the dyewood.

Brazil Wood.—The aqueous infusion of the wood of the Lima variety of Cæsalpina crispa[*] is of a pale brownish yellow colour, and acts in a remarkable manner on the light which it transmits. Fig. 6 represents the absorption which it produces in the spectrum. The first or least refrangible band is strongly marked, but the second is lighter, and rendered less evident by the considerable weakening of the spectrum beyond it. The addition of a dilute acid but little alters the colour of the solution; but, on examining with the prism, it is now seen to produce but one ill-defined band, intermediate in situation between D and E. On the addition of a small quantity of caustic ammonia to the infusion, the liquid changes to a fine ruby-red colour; it then absorbs the single band on the confines of the green, as represented in Fig. 7, while both ends of the spectrum are perfectly bright and clear. When alum is warmed with the aqueous infusion, the characteristic bands before apparent are replaced by a general absorption of the green rays. The alcoholic tincture of Brazil wood affords precisely the same reactions. Chevreul was, I believe, the first to separate a *red* crystalline substance from Brazil wood; to this body he gave the name Brazilin, as he supposed it to exist ready formed in the tree. Preisser, however, some years later, showed that *colourless* crystals can be obtained from the alcoholic extract by agitating it with hydrate of lead and subsequently decomposing the resulting compound with hydrosulphuric acid. The colourless substance so prepared he named Brazilin ($C_9H_{14}O_3$), and Chevreul's red compound Brazilein ($C_{18}H_{28}O_7$). Notwithstanding the doubts entertained of the accuracy of Preisser's statements, I must say that I have succeeded in preparing a nearly colourless substance from Brazil wood by Preisser's process, which,. when dissolved and treated with ammonia with exposure to the air, gave a coloured solution which acted upon transmitted light in a similar manner to the ordinary infusion of the wood. Of course the corroboration of Preisser's results in this direction in no way affects the objections which have been taken to his formula by Watts and others.

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[*] Pernambuco wood gives similar reactions.

Camwood, or Barwood.—The absorption spectrum afforded by the alcoholic solution or infusion of camwood is very remarkable on account of the considerable refrangibility of the bands which characterise it. Fig. 8 represents the appearance which we observe on examining the light transmitted by such a solution with the prism. It will be remarked that, in addition to the bands situated in the green and blue spaces, a slight shading on G is perceptible. If to the alcoholic liquid we add a drop of strong ammonia, the solution becomes of a dull purple-red colour, but gives the peculiar spectrum shown at Fig. 9. The first and least absorption occurs a little beyond D; the second band is strongly marked, but its borders are ill-defined. Potash acts in a similar manner. When boiled with the addition of a single drop of strong alum solution, the two bands of the simple alcoholic tincture are destroyed, and replaced by a shading of the spectrum between E and F. If to the original liquid a few drops of dilute nitric acid be added, a similar result is obtained; but in this case the absorption takes place between D and E.

Ozone.—The *Journal of the Franklin Institute* for April says that a youthful physicist of its acquaintance, who has one of those collections of chemicals and apparatus known as Crew's Laboratories, while trying the development of ozone by the action of a heated glass rod upon a mixture of air and ether, varied the experiment by substituting oxygen for air and a glass tube for a rod. Under these conditions, a tremendous detonation was the result of the introduction of the heated tube into the mixture. Supposing that the glass might have been too hot, he repeated the experiment, but again an explosion followed, although the tube was not sufficiently hot to burn the closed hand when drawn through it. A glass rod was then tried, but although at a low red heat, it produced no such result. The explanation is obvious. The position of mixed gas and vapour inside of the tube, being confined was so completely acted upon that ozone in sufficient purity and bulk to ignite the vapour or mixture was produced; while in the case of the rod, that part of the oxygen converted into ozone at each instant was too rapidly diffused and diluted for such a result.

ON THE DISTILLATION OF HYDROCARBONS.

By JOSEPH HIRSH, Ph.D.

On reading the note of Prof. B. Silliman, on his "Examination of some California tar,"* it occurred to me that similar experiments, when carried on with a view of ascertaining the qualitative and quantitative result of illuminating oil, should be executed under circumstances more parallel to the distillation on a large scale, in order to arrive at an approximately true result.

During distillation of natural hydrocarbons on a commercial scale, *i.e.* in large stills, the process of "cracking" always takes place to some degree; or, in other words, as all native hydrocarbons consist of mixtures of those substances of greatly varying boiling points, all hydrocarbons of high boiling points contained in such mixtures are during distillation exposed to various degrees of temperature below their own boiling point, as long as those hydrocarbons of lesser gravity and lower, boiling point have not been removed by distillation.

It is this exposure to a lower degree of heat than corresponds to the distilling point of an oil of definite gravity which comprises the operation of "cracking." If we consider that the stills used ordinarily in this country vary in capacity from 500 gallons to 20,000, and in single instances, as in the refinery of Reese and Graff, Pittsburgh, Pa., to 40,000 gallons a piece, the discharge of which varies in duration from one to six days, it will be evident that frequently, as in the last case mentioned, a portion of the oil, which may enter the still with a boiling point of, for instance, 400° F., will remain exposed for more than 100 hours to various degrees of increasing heat, all of which are below its own boiling point, as the heat of even the strongest fire is absorbed by the evaporation of the more volatile portions of hydrocarbons.

During this *normal* state of distillation in a still of such dimensions, the process of "cracking" will be taken advantage of in a supreme degree without any especial efforts or loss of time, the resulting distillate being of a light specific gravity and corresponding colour, while only a small portion distils over as paraffin oil, the latter being due to over heating, which with a small quantity can hardly be avoided in so large a still, on account of the peculiar shape which has to be given to it to insure sufficient strength, and the effect upon that of the fire. To this point I shall return again.

If we compare the distillation of 5 or 10 gallons with the above we find that in applying fire freely, the entire quantity may be distilled off in less than an hour, and cannot likely take more than a few hours—referring, as before, to a moderately intense heat. Here, according to the construction of the still or the manner of applying heat, the distillate will contain hydrocarbons of as high a specific gravity respectively, and as high a boiling point, as the crude oil did before entering the still, or even of a higher one, if the oily vapours were over heated.

In this case the two leading items in the distillation on a commercial scale, viz., time and a temperature below the actual boiling point of a portion of the oil, are entirely wanting, and their absence unavoidably greatly modifies the resulting product. If, then, we wish to distil a small quantity of hydrocarbons analogous to the manner in which this process is carried on on a large scale, we have to employ the process of "cracking" only. But even then very rarely has the time of executing such a distillation of a few gallons been extended beyond a small number of hours, and the consequence is a distillate with a comparatively high boiling point.

The difference between this last named distillation and that on a large scale is the same as the one between distilling coal for the production of illuminating gas and that for producing coal oils. The former, producing tar of great specific gravity, is, for the reasons mentioned, even on a large scale, carried on in comparitively small low retorts, while for the production of coal oils, the larger revolving retorts are found more desirable. In these, the oily vapours are exposed to a cooler temperature than their own, with every revolution of the retort, and are in this manner broken up into oils of lighter gravity, distinguished from the tar oils by their fitness for illumination.

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* Chemical News for June, No. 436, p. 171.

If, then, a few gallons of hydrocarbons are distilled with a view of presenting the probable results on a large scale, we ought to consider the amount of heating surface, which ought to be small, and only at the bottom of the still, together with the arrangements made for cooling the sides and upper portions of the distilling apparatus, as this materially influences the process of "cracking."

This may be more comprehensible by noticing the rules which by experience I found to regulate the distillation of carbon oils on an extensive scale.

1st. The difference of temperature between the actual boiling point of oil of definite gravity, and of the temperature to which it is raised, is proportionate to the effect of the process of "cracking," *i.e.*, the more the temperature of the actual boiling point of oil of definite gravity is above the temperature to which the same oil is raised, the greater is the quantity of light oil obtained. If then we wish to reduce the gravity of a very heavy oil greatly, we shall have to employ an exceedingly low temperature, so low sometimes as to suspend actual distillation for a short time.

2nd. The gravity of the distillate, resulting from reduction of temperature, will be directly proportionate to said reduction, *i.e.*, if we reduce the temperature to a degree at which only naphtha of 0·700 boils, the resulting distillate will possess a specific gravity of 0·700 regardless of the gravity of the original oil.

This law enables us to produce a distillate of any desired gravity (below that of the oil before distillation) from any crude oil, and a due regard to it enables us to produce an illuminating oil of the same specific gravity without great quantitative loss from the light Pennsylvanian oils, as that produced from the heavier Ohio, Canada, or California oils. In distillation the temperature therefore should always be reduced to the boiling point of oil of the specific gravity desired.

3rd. The difference between the temperatures of the two boiling-points, viz., of the oil being subjected to distillation, and of the desired distillate, is in direct proportion to the height of the still employed, or, which produces the same effect, to the facility for cooling the upper portions of the still. According to this law a heavy oil will yield the readier a light distillate the higher its vapours have to rise before leaving the still, because the reduction of temperature in those higher portions of a retort which are more remote from the source of heat acts upon the vapour of the oil in fine division, and reduces their gravity more readily than the compact liquid oil.

If the heat is applied solely to the bottom of the still, while its sides and top may be exposed to a current of cool air, the reduction of temperature of the oil vapours takes place similarly to, and can be controlled better than, the cooling in high stills without this provision.

The arrangements for cooling the sides and top of a still must therefore be the more complete the lower or smaller the still employed is. This law also teaches us that stills to be used for "cracking" oil should have a flat bottom, and should have the flues arranged in such a manner as to permit the restriction of the fire to the bottom only, which is necessary to the process of "cracking."

Where superheated steam is used as the heating medium it ought to be applied at the bottom only. Where the dimensions of a still become as huge as was mentioned in the beginning of this article, a flat bottom would hardly be strong enough; in this case the boiler shape is usually employed. In order to have a practically sufficiently large heating surface, the fire here has to reach up to a certain distance on the round boiler. If the quantity of oil present in the still is so small as to be below the boiler surface exposed to the fire, the raising oil vapours will be superheated on this surface, and the resulting distillate will be of greater specific gravity, and of darker colour than it normally would have been, the product resembling more the oils resulting from the distillation of coal-tar.

For this reason the residuum in such stills, after reduction to the quantity mentioned, is frequently removed to smaller stills. This diminution of temperature of the oil vapours causes a partial condensation and redistillation of the oil, which diminishes the colour and gravity of the oil.

4th. The intensity of the process of "cracking" is proportionate to the suddenness with which the oil vapours are condensed before leaving the still. The thorough application of this principle produces more rapidly those results mentioned as necessary in the preceding paragraph.

5th. The difference in gravity between that of the oil distilled and of the desired distillate is in direct proportion to the quantity of water produced in the process.

If from a very heavy oil an exceedingly light distillate is to be produced, the proportion of water is so immense as to show occasionally a distillate of water with but a minute percentage of oil floating on its surface. In all such cases small black particles of carbon float on the top of the water, forming an intermediate layer between the latter and the oil. The quantity of carbon separated in this manner is also proportionate to the quantity of water distilled over resp., to the intensity of the process of "cracking" employed. This carbon is mechanically carried over by particles of water, which in contact with oil always produce violent ebullition.

These laws are the same with hydrocarbons distilled under the ordinary atmospheric pressure as with those distilled in a vacuum or under increased pressure. In the two last-named cases the variation of boiling point corresponding to these different degrees of pressure has to be taken into consideration.

Referring once more to the article of Prof. Silliman, I would mention that I deem his concluding assertion—"The transformation of light oils into denser products like tar, to result not as has been supposed by some, from the addition of oxygen producing an oxidised body, but by the removal of successive atoms of hydrogen in the form of water,"—simply a different mode of expressing the opinion of others referred to, as the removal of hydrogen in the shape of water is certainly a perfect and true process of oxidation.

Western Chemical and Starch Works,
201 and 203 South Water Street, Chicago.
June 24th, 1868.

ON A NEW ALKALOID
CONTAINED IN
COMMERCIAL ANILINE AND ISOMERIC WITH TOLUIDINE.

By M. ROSENSTIEHL.

By the transformation of the toluol of coal tar into toluidine a non-crystallisable alkaloid is obtained. This has been remarked by several observers—amongst others by MM. Coupier and Graefinghoff; the latter explains the fact by admitting that toluidine may exist under two modifications, one liquid, the other solid, but he points out no other distinctive characteristics. Similar differences have been observed in nitro-toluol; M. Jaworsky obtained this product in the crystallised state; and M. Alexeyeff demonstrated that reduction transformed it into toluidine, totally and immediately crystalline. M. Kekulé concludes from these facts that the liquid nitro-toluol hitherto known must be impure.

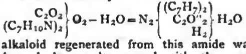
About three years ago M. Coupier introduced to commerce a toluidine but partially crystallisable, and containing only 20 per cent of aniline. To this liquid toluidine appertains the valuable quality of forming, with arsenical acid, a red colouring matter analogous to fuchsine. This property has hitherto been attributed to an admixture of aniline and toluidine; and the liquid form of M. Coupier's product was supposed to be due to the presence of a certain quantity of aniline.

Several facts are opposed to this view of the question. There is the constant boiling point of the alkaloid (198°), then its elementary composition, which answers to the formula of toluidine; and, lastly, the circumstance that the yield of pure red dye is vastly superior to that obtained from admixtures of pure aniline and crystallised toluidine in the most favourable proportions.—(*Bulletin de la Société Industrielle de Mulhouse*, p. 264, 1866.)

When liquid toluidine is cooled to below zero, and a drop of water thrown in, part of the mass solidifies, and the crystallised toluidine separates. The liquid which remains still possesses the boiling point and the composition of toluidine; but when treated with arsenic acid the yield of red is less—15 per cent in lieu of 45 per cent.

This liquid is the best primary substance for the preparation of the new alkaloid. It is to be transformed into oxalate, which is exhausted by ether free from alcohol; the undissolved portion consists of pure oxalate of toluidine: the part dissolved consists of an oxalate, crystallisable from ether, alcohol, and water. When decomposed by soda, this oxalate furnishes a liquid alkaloid. To ascertain that this was indeed a simple alkaloid, it was transformed into a chloride and separated by successive crystallisations into four deposits; each of these deposits was recrystallised, and its solubility in water determined. The constancy of this solubility was looked upon as a proof of complete purity. By the aid of this salt the free alkaloid employed in the following experiments was prepared.

Recently rectified over fused potash, this base is colourless, but colours gradually in the air. It remains liquid at −20°, its odour resembles that of toluidine, its density is 1·0002, and it boils at 198° at a pressure of 744 millimetres. Analysis led to the formula C_7H_9N. This formula was controlled by the analysis of its oxamide, which crystallises in beautiful silky looking needles, easily obtained quite pure. This amide differs from the oxalate by a molecule of water only :—



$$\left.\begin{matrix} C_2O_2 \\ (C_7H_{10}N)_2 \end{matrix}\right\} O_2 - H_2O = N_2 \left\{\begin{matrix} (C_7H_7)_2 \\ C_2O''_2 \\ H_2 \end{matrix}\right\} H_2O$$

The alkaloid regenerated from this amide was also analysed, and the results accord with the preceding analyses. As it is, therefore, an isomer of toluidine, I will call it pseudo-toluidine, that being the only name I feel justified in giving it, while still ignorant of its exact constitution. It is sufficiently plentiful—the liquid toluidine of M. Coupier contains about 36 per cent, commercial aniline often more than 20 per cent.

Pseudotoluidine does not seem to be identical, either with methylaniline, which boils at 192° (Hofmann, 1850, *Annalen der Chimie und Pharmacie*, lxxiv., p. 150); or with the alkaloid described by Limpricht, under the name of benzylamine (*loc. cit.*, cxiv., p. 304), which boils at 183°.

I have carefully compared the crystalline form, and the solubility of the chlorhydrate and oxalate, with those of the corresponding salts of aniline and toluidine. The establishment of this difference is very important. The form of the chlorhydrate is undeterminable; the salt of pseudotoluidine forms an orthorhombic prism; that formed by the toluidine is clinorhombic. Their solubility in the same order are respectively, in a hundred parts of water, 129 at 17°, 7; 37, 5 at 15°, 5; 22, 9 at 11°.

The coloured reactions of this solution are alike different to those of aniline and toluidine; but I shall return to this part of the subject in another communication.

When heated with arsenic acid, pseudotoluidine does not produce red, but if combined with pure crystallised toluidine, it yields an abundant red colouring matter, containing at least 50 per cent of a rosaniline salt; during the reaction much aniline also distils. An explanation of this remarkable fact would require a profound study of the composition of the new alkaloid.

Here is another circumstance not less striking. When mixed with aniline and treated by arsenic acid, pseudotoluidine produces plenty of red colouring matter, similar to fuchsine, but differing from salts of rosaniline in the solubility of its base in ether, and the still greater solubility of its chloride in water. It appears from its origin to be an isomer of rosaniline.

The anilines now employed in the manufacture of fuchsines contain much less aniline than formerly, but I have proved that they contain as much more pseudotoluidine. At the same time the composition of the reds is changed; the red which I have described must now be recognised, in addition to the chloride of rosaniline, whose formula Hofmann has so clearly established.

Salts of pseudotoluidine, mixed with chlorate of copper and applied on cotton, give a fine black; this black approaches violet, whilst pure aniline under the same conditions produces a blue black. I ought to observe, in concluding this summary, that the purity of the alkaloids used by me in the course of these experiments was verified by the laborious but sure process employed upon the pseudotoluidine.—(*Comptes Rendus*, lxvii., 45.)

ON THE PROXIMATE ANALYSIS OF COALS.

By Professor GUSTAVUS HINRICHS, Chemist of the Geological Survey of Iowa.*

Coal is not a simple chemical combination, expressible by a chemical formula; but it is the final residuum of vegetable matter having been exposed to a long-continued and complex process of addition and subtraction. An elementary analysis will therefore not teach us much in regard to the nature of the combustible; for who would dare to make any conclusion concerning the peculiar combination of the elements thus determined? Even the heating effect calculated from this elementary analysis is not more trustworthy than the valuation by the reduction of lead.

The proximate analysis, on the contrary, enables us to learn something in regard to the real nature of the fuel. The moisture and the ashes are both not only diluents of the fuel, but in themselves obstacles to the effectiveness of the same; the vaporisation of the moisture causes a serious loss of heat, while the ashes, by hindering a complete combustion, and by the heat they contain when dropped through the grate, constitute another loss. By furthermore determining the total amount of volatile matter, we learn both the percentage of coke in the fuel, and the amount of carbon (fixed combustible) and bitumen (volatile combustible matter). Although neither of these two products can be considered as simple chemical compounds, it is nevertheless of the utmost practical importance to know these two quantities, because of the great importance of coke and gas in the arts. The yield in gas of a fuel is no doubt measured by the percentage of bitumen, at least for coals from the same basin—coals which therefore may be supposed to have passed through nearly the same chemical history.

In taking charge of the chemical labours of the Geological Survey of Iowa, I had grave doubts in regard to the value of this proximate analysis of coals. No investigation as to its accuracy, nor as to the best method of conducting the work, had come to my knowledge. The European chemists seem almost exclusively to rely on the elementary analysis, while in the great government surveys of this country the proximate analysis seems to have been almost as exclusively practised. But while the former may readily be turned into approximate determinations of the heating effects of the fuel, the latter have, to my knowledge, never been used for such purposes, nor was it at all apparent that they ever could be thus made useful.

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* From the *American Journal of Mining*, published in advance of the official report.

In regard to the first condition of all quantitative determinations, that of giving constant results for the same substance, but few observations were accessible, and these rather increased my first distrust. Thus Whitney, nowhere in his report on the coals of Iowa (Geology of Iowa, vol. i., part 1), gives any data whatever in regard to this most important question, although he devotes a very large space to the subject. Only the final results are given; but whether the individual determinations deviated much or little from the same, cannot be ascertained; or, in other words, the degree of accuracy or reliability of his reported results is altogether unknown. The report of Dr. Jas. V. F. Blaney on the coals of Illinois (Geology of Illinois, vol. i., 1866, p. 258-277), insists on the great correspondence of the amount of bitumen volatilised to varying circumstances, but only in general terms, no experimental data being brought forward. Fortunately, this chemist gives for four samples of coal the direct result of two determinations; but the differences between these two determinations on the same sample are respectively

3·04 1·50 1·32 0·07

per cent, the mean of which is 1·48, or very nearly one and a half per cent. This result certainly was not calculated to incline me favourably to the proximate analysis of coals.

On the other hand, the usual applications of coal demand such analysis, and my reduction of the analysis of Whitney and Blaney (mentioned in No. 22 of the *American Journal of Mining*) proves, by the results obtained, that the determinations must be more reliable than the above figures would indicate.

It thus became necessary for me, before making any proximate analysis of the many samples of Iowa coals put into my hands by the State Geologist, Dr. C. A. White, to make a rather extensive and thorough search into the method itself, in order to study its exact value. Since I, in these determinations, according to the varied circumstances, for the same sample of coal, obtained values ranging from 41·77 to 57·31 per cent for the amount of volatile matter, it seems not only that such investigation was sufficiently called for, but even that it shows the proximate analysis to be worthless; a variation of 15·54, or rather 16 per cent for the same same sample, seems to condemn the method admitting of such results.

In the determination of magnesia, as large variations could be obtained by exposing the crystallised double phosphate to various conditions; and yet this determination, properly executed, is one of the most accurate known in analysis.

It is easily seen that the following elements will modify the result of the amount of volatile matter driven off from a sample of coal contained in a covered platinum crucible:—weight of coal and of crucible, degree and duration of heat, condition of coal. I hope to show that this determination, notwithstanding all these elements, admits of an accuracy of one-tenth of a per cent, equal to that of weighing a gramme exact to the milligramme.

The sample of coal used for this purpose was not selected, but taken at random; it was labelled No. 350, and is from the bottom of Roberts and Fisher's Bank, which bank is 5 to 6 feet thick, 7 miles west of the town of Pella, in Marion County, Iowa. From this sample a very pure piece, free from any visible admixture of either gypsum or pyrites, was selected. By means of 2·760 coal, in coarse fragments of about 1-10 cubic centimetre and a 50 gramme flask, the specific gravity of this coal was found to be 1.328.

Determination of the Volatile Matter.

Source of Heat.—A common Bunsen burner was used (red heat), and also a gas burner with six jets, surmounted by a French soufflet cylindrique (white heat), care being taken to keep the gas-cock in the same position by means of an arm of 10 inches in length. These two sources of heat we will denote respectively "B B," and "Blast."

The time was usually measured by means of a small sand-glass, running exactly three and a half minutes; this duration we will denote by *t*. Thus BB, *t* means that the crucible was exposed to the constant flame of the Bunsen burner during three and a half minutes.

Influence of Quantity of Coal.

1. Coal pulverised, not dried; heat, BB, *t*; cooled and weighed; then blast, *t*; then weighed again.[*]

N. of Exper.	Weight.	Volatile, pr. ct.	Deviation.	Crucible.
d	5·360	48·24	−1·14	19·2
n	1·910	49·58	+0·20	19·2
e	1·147	49·87	+0·49	11·6
o	1·031	49·85	+0·47	9·4
	Mean	49·38		

2. Coal in small fragments; heat as in 1.

N. of Exper.	Weight.	Volatile, pr. ct.	Deviation.	Crucible.
h	3·743	48·30	−0·94	19·2
g	1·130	50·18	+0·94	9·4
	Mean	49·24		

For the same heat, the amount volatilised is the greater the smaller the mass heated; whether the coal is in small fragments or pulverised hardly makes any difference; but since the bitumen passed of more regularly when the coal was pulverised, while, when in fragments, slight explosions sometimes occurred, the coal should be pulverised, for the determination of the bitumen.

3. Coal, pulverised, between 1 and 2 grammes; heat, as above.

N. of Exper.	Weight.	Volatile, pr. ct.	Deviation.	Crucible
n	1·910	49·58	−0·19	19·2
e	1·147	49·87	+0·10	11·6
o	1·031	49·85	+0·08	9·4
	Mean	49·77		

giving, as probable error of a single determination, only 0·108 per cent, or only 1 milligramme for 1 gramme of coal. This is not greater than that of the weighing itself, in which fractions of a milligramme were usually neglected.

4. Coal, pulverised (new portion), and between 1—2 grammes; heat, BB, *t*; immediately thereafter blast, *t*, without cooling.

N. of Exper.	Weight.	Volatile, pr. ct.	Deviation.	Crucible.
a'	1·160	50·86	+0·14	9·4
n'	1·040	50·58	−0·14	11·0
	Mean	50·72		

Another determination was made (*o*'), but on account of side-draft while over B B, the crucible cooled several times; correspondingly the result deviated much, being only 49·10.

From 3 and 4 we conclude, that if the substance taken is from 1 to 2 grammes, the result will be constant for the same mode of heating.

Influence of Drying the Coal before Ignition.

5. Coal, fragments; heat, B B, *t*; not cooled; blast, *t*. with the probable error of one single determination, 0·45.

N. of Exper.	Weight.	Volatile, pr. ct.	Deviation.
t	1·361	48·49	+0·76
u	1·060	47·26	−0·47
v	1·030	47·43	−0·30
	Mean	47·73	

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[*] Weight = coal taken in grammes; crucible = weight of the same. Deviation per cent from the mean given. These quantities are given in the same order in all subsequent tables, unless stated otherwise.

Comparing this with 4 (same heating), it appears that about 3 per cent less volatilised by previous drying, and also that the accuracy of one determination is four times less than when the coal is ignited without previous drying. In the arts, the coal is not artificially dried before coking. For all of these reasons, the amount of volatile matter is best determined on undried coal.

6. In general, I found, as means,

4 dried	coals gave	47·97 per cent	volatile
10 undried	,,	49·87 ,,	,,

confirming the above.

Influence of Cooling after the Ignition over the Bunsen Burner, and before the Ignition over the Blast-Flame.

7. Coal, pulverised, not dried; heat, B B, *t*; then blast, *t*, without cooling.

N. of Exper.	Weight.	Volatile, pr. ct.	Deviation.
x	1·314	49·01	−0·02
y	1·156	49·05	+0·02
	Mean	49·03	

which, compared with the corresponding case, 3, giving the mean 49·77, and maximum deviation 0·19, shows that by the intermediate cooling about ¾ per cent more is volatilised. This probably is due to the fact that the crucible upon cooling is filled with atmospheric air, which, upon renewed ignition, must burn a corresponding amount of coal.

Influence of Repeated Heating, the Crucible being after each Ignition Cooled and Weighed.

8. Coal = *r* = 1·628 in crucible 19·2 was dried, then ignited (B B, *t*), and lost 41·77 per cent. Being ignited again in the same way, it lost 2·76 per cent, or in all, 44·53. Being successively ignited seven times, B B, each time for six minutes, the total loss was 52·39, or, on the average for each of these six minute B B ignitions, 1·12 (two of the determinations nearest this average were 1·06 per cent.)

Hereafter the same was five times for three and a half minutes exposed to the blast; the volatile passed off amounted to 57·31, giving for each of these last ignitions the average loss of 0·98 per cent.

It now had been ignited fourteen times, each time having been cooled and weighed; and we have fourteen ignitions, 57·31 volatile—first ignition, 41·77 volatile; hence, average for each of the thirteen ignitions, 1·195, or 1·2 per cent.

This series of experiments shows that it is impossible to heat coal until no further loss is sustained; for it is apparent that each heating, after complete cooling, produces, on the average, more than the additional volatilisation of 1. On 1 gramme coal taken, 1 per cent carbon burnt requires about 30 milligrammes, or 20 cubic centimetres of oxygen. We may, therefore, consider these excesses almost equal losses due to a real combustion.

Influence of Protracted Heating.

9. Coal, pulverised, not dried; heat, always first B B, *t*; and then immediately, without cooling, transferred to blast-lamp.

No.	Weight.	Blast.	Volatile.	Difference.	Difference per minute.
a' + *n'*	(mean)	3 min.	50·72	0·57	0·19
c'		6 ,,	51·29	1·04	0·35
b'		9 ,,	52·33	1·95	0·65
d'		12 ,,	54·28	2·93	0·16
k'		30 ,,	57·21		

By comparing each with the first mean, we obtain for each minute blast after the first three, respectively,

0·24 0·39 0·27 0·20

showing less difference than the above.

The volatilisation, after the three first minutes blast, is therefore increasing ¼ to 2·5 per cent for six minutes, and then very slowly decreasing to about 1·5 per cent for half an hour. At this rate the loss is twelve per hour.

It is apparent that the loss is less than when cooled in the intervals, but it proves that a slight current of air must get at the coal in the covered crucible.

At any rate it is demonstrated, that the rule which is sometimes given, to heat until no further loss is sustained, demands an impossibility.

Influence of the Degree of Heat.

10. Coal, pulverised, not dried; heat, B B, *t*; cooled and weighed; then blast, *t*; cooled and weighed again.

After B B.

N. of Exper.	Weight.	Volatile, pr. ct.	Deviation.
n	1·910	48·08	+0·42
e	1·147	47·69	+0·03
o	1·031	47·23	−0·43
	Mean ..	47·66	
	Prob. error	0·284	

After Blast.

N. of Exper.	Volatile pr. ct.	Deviation.
n	49·58	−0·18
e	49·87	+0·11
o	49·85	+0·09
Mean ..	49·76	
Prob. error	0·108	

showing that the higher temperature gives the most accurate results.

Result.

From this investigation we conclude—

The total volatile matter of coal is determined with accuracy (1 mgr. on 1 gr. coal), by taking 1 to 2 grammes of undried, pulverised coal, heating it for three and a half minutes over a Bunsen burner (bright red heat), and then immediately, without cooling, for the same length of time, over a blast gas-lamp (white heat).

ON THE
OCCLUSION OF HYDROGEN GAS BY METALS.[*]

By THOMAS GRAHAM, F.R.S.,
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In my experiments, already published, on the occlusion of hydrogen by the metals palladium, platinum, and iron, the absorption of the gas was observed to be of uncertain occurrence at low temperatures, but was ensured by heating the metal, whether in the form of sponge or aggregated by hammering, and allowing it to cool slowly and completely in a hydrogen atmosphere. This fact was referred to the condition of absolute purity of the metallic surface being essential to the first absorbing action, as it is to the action of platinum foil or wire in determining the combustion of the gaseous mixture of oxygen and hydrogen, as observed by Faraday. A new method of charging the metals with hydrogen at low temperatures has lately presented itself, which is not without interest.

When a plate of zinc is placed in dilute sulphuric acid, hydrogen is freely evolved from the surface of the metal, but no hydrogen is occluded and retained at the same time. A negative result was indeed to be expected from the crystalline structure of zinc. But a thin plate of palladium immersed in the same acid, and brought into metallic contact with the zinc, soon becomes largely charged with the hydrogen, which is then transferred to its surface. The charge taken up in an hour by a palladium plate, rather thick, at 12° amounted to 173 times its volume.

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[*] From the *Proceedings of the Royal Society*, No. 103, 1868; with additions and corrections by the author.

The absorption of hydrogen was still more obvious when the palladium plate was constituted the negative electrode in acidulated water to a Bunsen battery of six cells. The evolution of oxygen gas at the positive electrode continuing copious, the effervescence at the negative electrode was entirely suspened for the first twenty seconds, in consequence of the hydrogen being occluded by the palladium. The final absorption amounted to 200·4 volumes, and was greater in amount than the volume of hydrogen occluded by the same plate heated and cooled in an atmosphere of the gas, which did not exceed 90 volumes.

It is worthy of remark that, although the hydrogen enters the palladium and no doubt pervades the whole mass of the metal in such cirumstances, the gas exhibits no disposition to leave the metal and escape into a vacuum, at the temperature of its absorption. Thus a thin plate of palladium, charged with hydrogen in the manner described, was washed, dried by a cloth, and then sealed up in an exhausted glass tube. On breaking the tube under mercury after two months, the vacuum was found perfect. No hydrogen had vaporised in the cold (about 12°); but on the application afterwards of a heat of 100° and upwards, 333 volumes of gas were evolved from the metal.

A similar result was obtained on making a hollow palladium cylinder, of which the length was 115 millimetres, diameter 12 millimetres, and thickness 1 millimetre, the negative electrode in an acid fluid, while the closed cavity of the cylinder was kept exhausted by means of a Sprengel aspirator. No hydrogen whatever passed through into the vacuous cavity in several hours, although the gas was no doubt abundantly absorbed by the outer surface of the cylinder and pervaded the metal throughout.

It appears, then, that when hydrogen is absorbed by palladium the volatility of the gas may be entirely suppressed; and hydrogen may be largely present in metals without exhibiting any sensible tension at low temperatures. Occluded hydrogen is certainly no longer a gas, whatever may be thought of its physical condition. The same conclusion was indicated by another series of experiments, in which it was found that, to be occluded by palladium, and even by iron, hydrogen does not require to be applied under much pressure, but, on the contrary, when highly rarefied is still freely absorbed by these metals.

The occluded hydrogen is readily extracted from palladium by reversing the position of the latter in the decomposing cell of the battery, so as to cause oxygen to be evolved on the surface of the metal. The hydrogen is then drawn out as rapidly as it had previously entered the palladium, and the metal is exhausted in a complete manner by such treatment. When palladium charged with hydrogen is left exposed to the atmosphere, the metal is apt to become suddenly hot, and to lose its gas entirely by spontaneous oxidation.

Platinum may be charged with hydrogen by voltaic action, as well as palladium, but with the usual inferior proportion of gas. The charge of hydrogen taken up in a decomposing voltaic cell by old platinum in the form of a tube, of the thickness of a small crucible, was 2·19 volumes. This absorbed gas was also readily withdrawn from the platinum and oxidised on reversing the place of the metal in the decomposing cell. The platinum acquired its well-known polarising-power in virtue of the occluded hydrogen. This power was retained by the metal after being washed with pure water and wiped with a cloth, and was brought into action on placing the metal in dilute acid. The temperature required to expel the hydrogen so absorbed by platinum was found to be little short of a red heat, although the gas had entered the metal at a low temperature.

Soft iron, left some time in a dilute acid, occluded 0·57 volume of hydrogen. This charge of gas was also retained at low temperatures, and did not escape into a vacuum till the temperature was raised nearly to redness. This proves that, like platinum, iron is not penetrated through in the cold by hydrogen, the temperature of emission being elevated considerably.[*]

While hydrogen was absorbed freely by palladium and platinum as negative plates, no oxygen whatever was absorbed by plates of the same metals in the position of positive electrodes. Oxygen gas was disengaged freely on the surface of the latter without being condensed. A platinum plate which had acted for several hours as a positive electrode, gave afterwards, when submitted to heat with exhaustion, a small trace of carbonic acid but no oxygen.

The familiar igniting-power of platinum sponge (or clean plate) upon a jet of hydrogen in the air seems to depend solely upon the influence of the metal upon its occluded hydrogen. The hydrogen appears to be polarised, and to have its attraction for oxygen greatly heightened. I beg to offer the following representation of this phenomenon, with an apology for the purely speculative character of the explanation. The gaseous molecule of hydrogen being assumed to be an association of two atoms, a hydride of hydrogen, it would follow that it is the attraction of platinum for the negative or "chlorylous" atom of the hydrogen molecule which attaches the latter to the metal. The tendency, imperfectly satisfied, is to the formation of a hydride of platinum. The hydrogen molecule is accordingly polarised, *orienté*, with its positive or "basylous" side turned outwards, and having its affinity for oxygen greatly enlivened. It is true that the two atoms of a molecule of hydrogen are considered to be inseparable; but this may not be inconsistent with the replacement of such hydrogen atoms as are withdrawn, on combining with oxygen, by other hydrogen atoms from the adjoining molecules. It is only necessary to suppose that a pair of contiguous hydrogen molecules act together upon a single molecule of the external oxygen. They would form water, and still leave a pair of atoms, or a single molecule of hydrogen, attached to the platinum.

The oxidation of alcohol, ether, and similar hydrocarbons, through the agency of platinum, likewise appears to be always an immediate consequence of a similar polarisation of the hydrogen of those substances, or of some other oxidisable constituent.

As has already been remarked, it does not follow that, because a gas is occluded by a metal, under the pressure of the atmosphere, at a low temperature, the gas will also escape from the metal into a vacuum at the same temperature, a much higher temperature being often required for the expulsion of the gas than for its first absorption. This is particularly true of carbonic oxide occluded by iron. Cast iron is much too porous for such experiments, and allows carbonic oxide, equally with other gases, to pass through abundantly by the agency of gaseous diffusion. Even with malleable iron there is a difficulty in observing, owing to the long time during which that metal continues to discharge carbonic oxide from its own store of that gas. But a malleable iron tube, first thoroughly deprived of its natural gas, was found to allow carbonic oxide to pass through it into a vacuum very slowly compared with hydrogen, although the volume of carbonic oxide which the metal is capable of absorbing is very sensible, amounting to four volumes, and more considerable than the volume of hydrogen which the same metal can occlude. Carbonic oxide did not sensibly pass through iron of 1·7 millimetre in thickness till the temperature was greatly elevated; and then the passage of gas was, in a minute—

Of carbonic oxide, at a full red heat, 0·284 cubic centimetres per square metre of surface.

Of hydrogen, at a full red heat, 76·5 cubic centimetres per square metre of surface.

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[*] In M. Cailletot's experiment of exposing a thin sheet of iron to an acid, the metal is no doubt penetrated through by hydrogen in the cold, but apparently from the penetrating agency of the acid which is insinuating itself into the metal at the same time.—*Comptes Rendus*, May 4, 1868.

The condition of hydrogen as occluded by a colloidal metal may be studied with most advantage in its union with palladium, where the proportion of gas held is considerable. In the pulverulent spongy state, palladium took up 655 volumes of hydrogen; and so charged it gave off no gas *in vacuo* at the ordinary temperature, nor till its temperature was raised to nearly 100°. Hammered palladium foil has been observed to take up quite as much gas. But the condition in which palladium appears to be most absorptive is when precipitated from a solution of about 1·6 per cent of the chloride, by the action of a voltaic battery, in the form of a compact metal. Palladium is not one of the metals readily thus precipitated; but it may be thrown down upon a thin platinum wire, in brilliant laminæ, by the action of a large single cell. The palladium after a time detaches itself from the wire, exhibiting a bright white metallic surface where it had been in contact with the platinum, and a dull surface suggesting metallic arsenic, on the side exposed to the acid. As so prepared, it does not contain any occluded hydrogen. But the metallic films, when heated to 100° in hydrogen, and allowed to cool slowly for an hour in the same gas, were found to occlude 982·14 volumes of gas, measured with the thermometer at 11°, and barometer at 756 millimetres. This is the largest absorption of hydrogen observed. From palladium so charged there was a slight indication of the escape of hydrogen into a vacuum, with extreme slowness in the cold. This charged palladium is represented by weight as—

Palladium 1·0020 grm.	99·277
Hydrogen 0·0073 grm.	·723
	100·000

It is in the proportion of one equivalent of palladium to 0·772 equivalent of hydrogen,* or there is an approximation to single equivalents Pd H. But the idea of definite chemical combination is opposed by various considerations. No visible change is occasioned to the metallic palladium by its association with the hydrogen. Hydrides of certain metals are known, as the hydride of copper (Wurtz) and the hydride of iron (Wanklyn); but they are brown pulverulent substances with no metallic characters. Indeed a hydride of palladium itself can be formed, but not preserved, on account of its great instability. Following the process of M. Wurtz for the hydride of copper, nitrate of palladium was boiled with sulphuric acid, and the sulphate of palladium (a red crystalline salt) prepared. A solution of this salt, with an excess of sulphuric acid, was precipitated by the hypophosphite of soda; a black powder fell, which speedily underwent decomposition at 0°, evolving copious volumes of hydrogen gas. The final residue appeared to be pure palladium, of its usual black amorphous appearance, and with no trace of crystallisation. It is singular that this palladium precipitate contained no occluded hydrogen; and even when dried, and afterwards exposed to an atmosphere of hydrogen in the usual manner, the palladium black so prepared condensed no sensible quantity of that gas. It acquired this property, however, after being heated to redness and converted into grey palladium.

I am inclined to conclude that the passage of hydrogen through a plate of metal is always preceded by the condensation or occlusion of the gas. But it must be admitted that the rapidity of penetration is not in proportion to the volume of gas occluded; otherwise palladium would be much more permeable at a low than at a high temperature. A plate of that metal was sensibly exhausted of hydrogen gas at 267°, but continued permeable, and in fact increased greatly in permeability at still higher temperatures, and without becoming permeable to other gases at the same time. In a striking experiment, a mixture of equal volumes of hydrogen and carbonic acid was carried through a small palladium tube, of which the internal diameter was 3 millimetres, and the thickness of the wall 0·3 millimetre. From the outer surface of this tube gas escaped into a vacuum, at a red heat, with the enormous velocity of 1017·54 cubic centimetres per minute for a square metre of surface. This gas did not disturb baryta-water. It was pure hydrogen.

A still more rapid passage of hydrogen was observed through the substance of a hollow cylinder of palladium 1 millimetre in thickness, at a higher temperature, approaching the melting-point of gold. The palladium cylinder being enclosed in a porcelain tube charged with pure hydrogen, was exhausted as usual, and gave 105·8 cubic centimetres of gas in five minutes; measured with barometer 753 millims., thermometer 10°. As the external surface of the palladium tube amounted to 0·0053 square metre, the passage of gas was—

3992·22 cubic centimetres (4 litres nearly) from a square metre of surface, per minute.

The rate of penetration of hydrogen through the same palladium tube, at the lower temperature of 265° C., was previously observed to be—

327 cubic centimetres from a square metre of surface, per minute.

The velocity of penetration thus appears to increase in a rapid ratio with the temperature.

When carbonic acid was substituted for hydrogen, at the same high temperature, a very minute penetration was perceived, amounting to—

1·86 cubic centimetres from a square metre of surface, per minute.

This gives for carbonic acid one twenty-thousandth part of the rate of hydrogen. Whether it is a penetration of the same sort, although greatly less in degree, or rather the consequence of a sensible porosity in the palladium (of which it would become the measure), remains uncertain.

The quantity of hydrogen held by the metal at these high temperatures may become too small to be appreciated; but I presume it is still present, and travels through the metal by a kind of rapid cementation. This extreme mobility is a singular property of hydrogen, which was involved in the fundamental discovery, by MM. H. Sainte-Claire Deville and Troost, of the passage of that gas through plates of iron and platinum at high temperatures.

The marked rapidity of the passage of the same gas through a thin sheet of caoutchouc appears to be more capable of explanation on known principles. Caoutchouc of less than 0·1 millimetre in thickness, if impregnated with hydrogen, loses its gas entirely by the most momentary exposure to the air. A tube of two millimetres in thickness, through which hydrogen and carbonic acid were singly passed, each for an hour, was found to retain—

Of hydrogen	0·0113 volume.
Of carbonic acid . . .	0·2200 ,,

The absorption, then, is in the proportion of one hydrogen to twenty carbonic acid; but the comparative rate of penetration of the two gases through a sheet of caoutchouc is as one hydrogen to two and a half carbonic acid; or the hydrogen moves eight times as rapidly as the density of its solution would indicate. But these gases differ in diffusibility as carbonic acid 1 to hydrogen 4·7. The rapid passage of hydrogen through caoutchouc is thus partly explained by the rapid manner in which that gas is brought to one surface of the sheet and conveyed away from the other by gaseous diffusion. Again, both substances travel through the substance of the caoutchouc by their diffusibility *as liquids*. Suppose hydrogen in that form to be nearly as much more diffusive than the other substance as it is when both are gaseous, than the observed rapid passage of hydrogen through caoutchouc would appear to be fully accounted for.

Liquid diffusion has also a bearing upon the rapid dissemination of hydrogen through a soft colloid metal, like palladium or platinum, at a high temperature. The liquid diffusion of salts in water is known to be six times as rapid at 100° as at 0°. If the diffusion of liquid hydrogen increases with temperature in an equal ratio, it must become a very rapid movement at a red heat. Although the quantity absorbed may be reduced (or the channel narrowed), the flow of liquid may thus be increased in velocity. The whole phenomena appear to be consistent with the solution of liquid hydrogen in the colloid metal. The "solution affinity" of metals appears to be nearly confined to hydrogen and carbonic oxide, so that metals are not sensibly penetrated by other gases than these.

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* H=1, Pd 106·5.

FOREIGN SCIENCE.

PARIS, JULY 29, 1868.

Detection of chloride in commercial bromide of potassium.—Chlorophyl. ACADEMY OF SCIENCES: Phosphate of lime.—Action of ether in contact with iodide of potassium.—Origin of peridotic products.—Density of calomel vapour and formulæ of the chlorides of mercury.

AT a meeting of the *Société de Pharmacie*, M. Baudrimont gave an account of "A Process for Detecting the Presence of Chloride in Commercial Bromide of Potassium." The bromide to be examined is first tested for iodine. For this purpose a small quantity of the salt is dissolved in water in a test tube, and an equal volume of bisulphide of carbon added. Upon the addition of a few drops of bromine water, the bisulphide of carbon becomes coloured violet, under the influence of iodine, if this be present. When the test shows the presence of iodine, it is necessary to remove the whole of this element from the sample. This is effected by dissolving about 10 grammes of the salt in distilled water, adding bromine water until violet vapours are no longer visible upon boiling, and then testing for iodine in the manner first described. Afterwards the solution is evaporated to dryness to remove the excess of bromine, and thus one obtains a bromide of potassium free from iodide, but which may contain chloride. The remainder of the process depends upon the fact, that a given weight of chloride of potassium requires a much greater amount of a standard solution of nitrate of silver than the same weight of bromide of potassium; while the bromide for the complete precipitation of 1 gramme requires 1·428 grammes of nitrate of silver, 1 gramme of the chloride requires 2·278 grammes. For the examination of the bromide of potassium, a standard solution of nitrate of silver is first prepared by dissolving, in a litre of water, 10 grammes of the pure salt, each 1-10th c.c. corresponding to 1 milligramme of nitrate of silver. 1 gramme of the bromide to be examined, freed from iodine if necessary, is dissolved in 100 c.c. of distilled water; 10 c.c. of this solution, representing ·1 gramme of bromide of potassium, would require, if pure, 14·2 c.c. of the silver solution; chloride of potassium would require 22·7 c.c. M. Baudrimont proposes a method of making the final reaction more delicate, by adding a few drops of solution of chromate of potash to the bromide examined; the nitrate of silver added then combines with the whole of the bromine and chlorine in preference, and the complete precipitation is marked by the production of the red precipitate of chromate of silver. It is obvious that the bromide contains more or less chloride, according as the number of burette divisions (divided into 1-10th c.c.) of the silver salt required, exceeds 142. With a salt containing one-tenth of its weight of chloride of potassium 151 divisions are required, and with a mixture of equal weights of chloride and bromide, 185. The same method may be employed to recognise the degree of purity of several compounds. Operating as before—that is to say, dissolving 1 gramme of the material to be examined in 100 c.c. of distilled water, and taking 10 c.c. of the solution—the following numbers of 1-10th c.c. divisions required will show the purity for at least a considerable number of salts:—102 for pure iodide of potassium, 257 for cyanide of potassium, 246 for dry carbonate of potash, 290 for chloride of sodium, 119 for carbonate of soda + 10 equivalents of water, 47 for phosphate of soda + 24 equivalents of water, and 54 for arseniate of soda + 14 equivalents of water.

In a note, entitled "Researches on Chlorophyl," by M. Filhol, presented to the Academy of Sciences, he states that all the methods of preparing chlorophyl requiring the aid of acids decompose this substance, and furnish, not chlorophyl, but the products which result from its decomposition. The organic acids, the action of which is less powerful, destroy the green colour of solutions of chlorophyl; this substance splitting up into two substances, one of which separates in the solid state in the form of black flakes, while the other remains in solution, and is of a fine yellow colour. The yellow matter, treated with concentrated hydrochloric acid, is separated into a solid substance which can be isolated by filtration, and which is yellow, and a blue substance which remains dissolved. The latter becomes yellow when the acid which has produced it is saturated. The yellow solid matter which separates when the hydrochloric determines the production of the blue colour, contracts the property of becoming blue under the influence of acids, when boiled for a few minutes with potash, soda, or baryta, in contact with the air. The green parts of the plants always contain, as well as chlorophyl, the two yellow substances spoken of. It is easy to obtain them without the intervention of acids. Treatment with animal black, in insufficient quantity to completely decolourise the solution, suffices with a solution of chlorophyl; after a few trials the proper amount is arrived at, and, upon filtering, a yellow-coloured liquid is obtained, which behaves with hydrochloric acid like that obtained in decomposing chlorophyl with an organic acid. These two yellow matters exist, then, in the free state by the side of chlorophyl in all plants. The young shoots of certain varieties of fusanus which are cultivated as ornamental plants, contain these two yellow substances, without the least trace of chlorophyl. The brown solid matter which is separated upon the addition of oxalic acid to a solution of chlorophyl is rich in nitrogen; it is identical with that described and analysed as constituting pure chlorophyl, by MM. Miller and Morot. Solutions of this brown matter possess in a high degree the dichroism common to solutions of chlorophyl; solutions of the yellow matter do not possess this property. The solutions of the brown matter become orange-yellow tinted under the influence of caustic alkalies and the air; this tint soon changes and becomes a pure green by absorption of oxygen.

On the 29th of June, the following communications were made to the Academy:—"On the Diathermancy of Chloride of Potassium," by M. Magnus; "Facts concerning the History of Phosphate of Lime," by MM. Dussart and Pelouze; "On the Manner in which Ether Acts in contact with Iodide of Potassium," by M. Houzeau; "On the Eruptive Origin of Peridotic Products," by M. Bertrand de Lom; "On the Distribution of the Flow of Heat, and of Conductibility In Homogeneous Crystalline Media," by M. Morin; "On the Introduction of a Resistance, termed Dynamic, in the explanation of Phenomena of Induction," by M. Le Roux; "On the Density of the Vapour of Calomel," by M. Debray; "New Researches on the Action of Dry Hypochlorous Acid on a Mixture of Iodine and Acetic Anhydride," by M. Schützenberger; "On the Property of Oxygen of Re-lighting Ignited Bodies," by M. Robinet; "Remarks on the Various Causes which may lead to Feeble Variations in the Indications of Balances."

In their memoir, entitled "Facts Concerning the History of Phosphate of Lime," MM. Dusart and Pelouze remark that when gelatinous phosphate of lime is placed in a vessel containing some litres of water saturated with carbonic acid, after some time the carbonic acid will be found to have disappeared in part, and the phosphate itself to have sensibly diminished. The transparent liquid obtained by filtration, gives by heat a crystalline precipitate, composed of phosphate and carbonate of lime. The phosphate formed is no longer tribasic, but a bibasic phosphate due to the elimination of an equivalent of base from the preceding salt. To demonstrate this, they take some of the precipitate and expose it to a moderate heat, so as to remove all the water which the salt contains, without, however, decomposing the carbonate; this operation converts the bibasic phosphate into pyrophosphate. After cooling, the substance is dissolved in cold hydrochloric acid, and precipitated by ammonia. In an experiment the ignited precipitate weighed ·51; it was again digested with dilute hydrochloric acid for some hours, treated with chloride of calcium, and finally precipitated by ammonia. This precipitate, after ignition, weighed ·62; the difference ·11 represents the exact quantity of oxide of calcium sufficient to transform the pyrophosphate into bibasic phosphate. Tribasic phosphate attacked by carbonic acid always gives rise to a product mixed with carbonate of lime. When a solution of acid phosphate of lime is mixed gradually with precipitated carbonate of lime, effervescence takes place, at the same time that a crystalline white solid is deposited. If the proportion of carbonate of lime is sufficient, the liquor is almost completely deprived of acid phosphate; washing first with acid phosphate, and afterwards with distilled water, brings the salt to a sufficient state of purity for analysis. Thus prepared, the bibasic phosphate of lime is a white granular crystalline body, slightly soluble in distilled water (·28 in 1000), more soluble in water charged with carbonic acid (·66 in 1000); it contains six equivalents of water, one of which is water of constitution, the composition being expressed by the formula $2CaO, HO, PO_5, 5HO$. It differs from that obtained by double decomposition with phosphate of soda and chloride of calcium, which contains only three equivalents of water. Bibasic phosphate of lime is produced either by acting upon tribasic phosphate of lime with carbonic acid, or by reacting with acid phosphate of lime on the carbonate.

The density of the vapour of subchloride of mercury has been determined by Mitscherlich, and more recently by MM. Deville and Troost; the number found by these later experimenters ($D = 8·21$) differs little from the theoretical number 8·15, calculated in supposing that the formula $HgCl$ corresponds to four volumes of vapour ($Hg = 200$, $Cl = 35·5$, $H = 1$, representing two volumes). But chemists, who with M. Wurtz adopt modern ideas upon atomicity, represent calomel by the formula Hg_2Cl_2, and as, on the other hand, they do not admit that the formula of a body can correspond to 8 volumes of vapour, they suppose that the protochloride of mercury is split up at the temperature at which its vapour density is taken into metallic mercury, Hg, and bichloride, $HgCl_2$, occupying each four volumes of vapours. M. Debray quotes a statement of M. Wurtz to this effect, from *Leçons de la Société Chimique*, 1864, p. 163. "It is easy to demonstrate," M. Debray continues, "on the contrary, that calomel is not decomposed, even partially, into mercury and bichloride, at least under the circumstances in which its vapour density is taken, since a plate of gold introduced into the flask where this density was taken, at 440° (temperature of boiling sulphur), maintained all its lustre and malleability. If any assurance of the delicacy of this test were required, one need only bring a plate of gold in contact with the vapours of biniodide of mercury, at a temperature approaching dull redness; this compound commencing to dissociate in these conditions, the plate of gold is found, after the experiment, whitened by the mercury, and so brittle as to be reduced to powder by the pressure of the fingers. Consequently, calomel suffers no dissociation, not even a partial dissociation at 440°; and if its formula were well established to be Hg_2Cl_2, it would have to be joined to the list of bodies whose vapour densities correspond to eight volumes." Such are M. Debray's conclusions.

NOTICES OF BOOKS.

What should we Drink? By J. L. Denman. London: Longmans, Green, & Co.

The material prosperity of this country owes much more to a constant process of delegislation than to the making of new laws. From corn-law repeal down almost to the present period, most of the beneficial work of Parliament has consisted in sweeping away the grievous fiscal laws imposed by the unwisdom of our forefathers upon body and mind—upon our food, raiment, the materials of our dwellings, and the means of knowledge. For more than a century wine has been subjected to a perverse fiscal contrivance, as if for the very purpose of vitiating the national taste, fostering gout and rheumatism, and in other ways spoiling human tissue. That for a hundred years this country should remain content to drink only coarse factitious wines, called port and sherry, will, we doubt not, prove a marvel to the next generation. Thanks to Mr. Gladstone, we may now, if we will, drink wine pure and good, and cheap; but our past blind fiscal arrangements regarding wine and the trading interests therewith interwoven, have enveloped the subject in a cloud of ignorance and prejudice, which only time and free discussion can disperse. To Mr. Denman the public ought to be much obliged for his vigorous onslaught upon the brandied, elderberried, unwholesome wines of Spain and Portugal, and for his ruthless exposure of the nefarious system of "applied chemistry" to the manufacture of so-called wines in force at Cette and Hamburgh. To Mr. Denman we owe the first introduction to the English market of the excellent Hungarian wines; and every one knows that to him we are indebted for naturalising Greek wines in England. If we cannot go quite so far as Mr. Denman, whose interest as a wine merchant may be supposed unconsciously to stimulate somewhat his enthusiastic advocacy, we are quite prepared to say that he has conferred no inconsiderable boon upon the community by the enterprise and judgment which led to the introduction of Greek wines into this country. Having divested himself of prejudice against novel wines, let anyone, whose taste has got beyond the low stage of port and sherry, try some of the drier sort from Mr. Denman's list, and if they do not commend themselves to his palate by all the characteristics which should distinguish natural wine—homogeneity, delicate sub-roughness, body, bouquet, and the power of conferring an *ab imo pectore* sense of well-being—the failure, we take it, ought not to be attributed to the wines. For the "sick and the sorry" the writer hereof—a physician—can testify to their nerve-nourishing, comforting, and invigorating virtues. We have referred to these wines as "novel," but—shade of Bacchus!—Greece is the classic soil of the vine. She gave to the wine-growing countries of Europe the cuttings whence sprung their wide-spreading vineyards. Long ere the vine clad the slopes of the Rhine, the banks of the Garonne, or covered the Côte d'Or, it flourished on the volcanic soil of Greece. Free now from Turkish oppression, the alert commercial spirit of the Greeks may yet furnish us with unrivalled wine, such as won lavish praises from their antique poets, and so, in one respect at least, Greece may once again "teach the nations how to live."

MISCELLANEOUS.

Newcastle Chemical Society.—On Monday evening last, a meeting of the members of the Chemical Society, newly formed in connection with the Newcastle Literary and Philosophical Society, was held in the committee room at the Institute, Mr. R. C. Clapham in the chair. The Chairman observed that two or three years ago it appeared to him that in a district like this, possessing so many large manufacturing concerns, and also extensive collieries, in each of which chemistry held an important position, it would be very desirable to have some centre or focus round which to meet, in order to occasionally discuss the various new projects and schemes that appeared from time to time. Many inventions were passed aside in the hurry and bustle of ordinary business life, and when they met occasionally and discussed in a friendly manner the various inventions with which the world at the present time teemed, perhaps they might be of use to the district, and able to add, a mite it might be, but still something to the prosperity and success of the district. The Chairman then desired the Secretary (Mr. Marreco) to read the report of the provisional committee. The report stated that the rules agreed to at the preliminary meeting had been revised by the provisional committee, and with some unimportant alterations, now presented the same to the general meeting for final approval. The provisional committee had also solicited the use of the Neville Hall lecture theatre, should the Society at any time require a larger accommodation than the committee room of the Literary and Philosophical Society afforded. The report further stated that the number of gentlemen, besides the gentlemen whom it was proposed to place upon the committee, who had signified their intention of joining the Society, was twenty-five. The rules were then discussed *seriatim*, and with some further amendments, were adopted. The following committee, nominated by the provisional committee, were elected:—President, Mr. I. L. Bell; Treasurer, Mr. John Pattinson; Secretaries, Dr. Geo. Lünge and Mr. A. F. Marreco; Committee, Messrs. H. Bowman (Washington), H. B. Brady, R. C. Clapham, G. France, B. S. Procter, J. W. Swan, W. H. Richardson, and E. I. J. Browell. For the securing of members, the meeting resolved that the Secretary send copies of the rules, the minutes of that meeting, and stamped envelopes with the following printed form:—"I request you to propose my name as a member of the Newcastle Chemical Society," to persons likely to become members of the Society. The number of members enrolled up to Monday evening was 39. The first meeting of the Society will take place in October.

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2042. E. Mucklow, Manchester, "Utilising refuse tanning matter for dyeing purposes." Petition recorded June 25, 1868.

2129. J. B. Brown, Walker, Northumberland, "Improvements in furnaces for calcining ores and other mineral substances."—July 3, 1868.

2137. E. H. Newby, King William Street, London, "Improvements in reducing aluminium from its ores or earths, and in producing alloys therefrom."—A communication from A. L. Fleury, Boston, Mass. U.S.A.—July 4, 1868.

2144. A. Fryer, Manchester, "Improvements in the mode of treating, for evaporating and concentrating purposes, cane juice, beetroot juice and other saccharine and other solutions and liquids, and in the construction of apparatus for the concentration of saccharine and other solutions and for the evaporation of liquids."—July 6, 1868.

2148. G. Davies, Serle Street, Lincoln's Inn, Middlesex, "Improvements in dyeing."—A communication from A. J. J. d'Andiran and G. Wegelin, Paris.

2152. E. Coppée, Haine St. Pierre, Belgium, "Improvements in the construction of coka-furnaces."—July 7, 1868.

NOTICES TO PROCEED.

1972. A. M. Clark, Chancery Lane, "Improvements in the purificasion of ceramic, vitrifiable, and other matters, as also of the crucibles, furnaces, or vessels used for containing the same."—A communication from L. Clémandot and E. Rousseau, Boulevart St. Martin, Paris."—June 17, 1868.

741. J. Lewthwaite, Woburn Place, Middlesex, "Improvements in treating the material known as 'parkesine' and in applying it to various useful and ornamental purposes."—Petition recorded March 4, 1868.

775. J. M. Stanley, Rhyl, Flintshire, "Improvements in the contruction of furnaces."

776. J. Whittaker, Manchester, "Certain improvements in the preparation of paper to be employed in the manufacture of waterproof paper."—March 6, 1868.

836. F. Winser, Manchester, and J. Swindells, Keyworth, Leicestershire, "Improvements in the manufacture of sulphate of magnesia."—March 11, 1868.

861. M. Rowand, Lewisham, Kent, "Improvements in the treatment or preparation of the ingredients employed in the manufacture of fermented liquors."—March 13, 1868.

1023. J. Jameson, Gateshead, Durham, "Improvements in the preparation of safety paper."—March 25, 1868

1467. J. Hickmott, Clapham, Surrey, "Improvements in preserving metallic articles from oxidation and decay."—May 5, 1868.

NOTES AND QUERIES.

Utilisation of Sewage.—I shall be glad to know particulars and names of inventors of the alum and lime processes for the utilisation of sewage mentioned in the notice of Mr. Sillar's new process in No. 448 of the Chemical News.—F. J. R.

Lubricating Composition.—Will any of your practical correspondents inform me through the medium of your valuable paper how to make a good and cheap lubricating composition, suitable and adapted for lubricating rolling mills and hot bearings, which is generally termed "Hot-Neck-Grease?"—Aberkenfig.

Gallipoli Oil.—I have a quantity of Gallipoli oil, expressed from shoddy, which is of a very dark colour, originating, I presume, from contact with the dyeing materials used in the manufacture of cloth. Can any of your learned correspondents tell me how to bleach the same, and bring it to its original colour without distilling?—Oilman.

Indigo.—I have occasion to use a considerable quantity of a solution of indigo made from the commercial extract of indigo, which, upon the addition of clean cold water, turns a slight green colour, not at all like the original colour of indigo. Can any of your numerous correspondents tell me how to remedy this evil, and keep the solution of a deep blue, or what substance can I add in order to deepen its colour?—Chemical Novice.

Bichloride of Methylene.—Seeing an enquiry in one of your notes and queries columns relative to bichloride of methylene, I thought it might be interesting to extract for the benefit of your readers the following account, which Dr. B. W. Richardson gives of this body. It is from the reports of the British Association just published. Dr. Richardson says that bichloride of methylene (CH_2Cl_2) is formed by the action of nascent hydrogen on chloroform, and it differs from chloroform, in that one atom of chlorine is replaced by an atom of hydrogen. Its boiling point is 88° Fahr., and the odour of its vapour is sweet and much like that of chloroform.—Atkins Holloway.

Philosophy of Pie-juice.—I shall be extremely obliged if you will inform me upon what grounds you object to my conclusions on the Philosophy of Pia-juice. I am open to conviction, and I shall be very glad if you will explain the matter for the edification of your readers, as a simple denial or a gratuitous statement without explanation will not I fear convince; at present I believe that sugar baked with the fruit sweetens it, but double the quantity added after does not counteract the acidity; the sugar and acid remain in their original state.—M. A. Baines.

[The *onus probandi* rests with our correspondent. We said last week that the following assertion had no sufficient foundation:—"No amount of sugar will sweeten fruit after it is cooked, for the sugar and the acid will not then amalgamate." It is not surely meant that sugar acts the part of an alkali in neutralising acids. In objecting to the *explanation* we do not necessarily doubt the *fact*, corroborated as it seems to be by general household experience, although it appears at variance with scientific notions. Probably a careful examination into the chemistry of the process would throw some light into the hidden mysteries of a raspberry and currant pie.—*Ed. C.N.*]

TO CORRESPONDENTS.

Chloride of Barium.—Messrs. Gaskell, Deacon, and Co., of Widnes, who are now manufacturing this salt in large quantities, have forwarded to us a small sample for laboratory use. We have tested it and found it to be remarkably free from impurity, and suitable for the preparation of test solutions.

F. J. R.—1. See Notes and Queries. 2. Write to Mr. H. Baillière, 219, Regent Street, W.

A. L. Steavenson.—In our next.

M. Tessie de Motay.—Can any correspondent oblige us with the address of this gentleman?

C. E.—We are not aware of the existence of any such society. An advertisement in the French Journal *Les Mondes* will be almost certain to procure what you want; it can be sent through our office.

T. H. Heath.—"Gesner on Coal Tar," to be procured at Baillière's.

Communications have been received from Gaskell, Deacon, and Co. (with parcel); A. P. Hurlstone; Dr. J. E. Reynolds (with enclosure); Dr. A. L. Steavenson (with enclosure); W. H. Langford; J. Brode and Co.; F. J. Rowan; L. Summering; J. Chalmers; R. R. Tatlock; D. Forbes, F.R.S.; Professor Pepper; Maclachlan and Stewart; Smith and Son (with enclosure); T. Morson (with enclosure); Murray and Heath (with enclosure); Prentice and Co.; J. Reid; Dr. Rohrig (with enclosure); G. F. Rodwell (with enclosure) W. Little; Mrs. Baines; Dr. R. Angus Smith; and J. Ireland, Jun.

THE CHEMICAL NEWS.

Vol. XVIII. No. 453.

ON THE TRANSMUTABLE NATURE OF WATER.[*]

Let us be excused for stating the elementary fact, that when an electric current is passed through water, the water is decomposed, oxygen appearing at one pole and hydrogen at the other; whence chemists have hitherto naturally inferred that water is a compound of oxygen and hydrogen, a conclusion confirmed by other facts of a chemical character. As the battery power increases, the distance between the poles in the decomposing cell may be increased. With still higher power, two cells may be used, one for each pole, and the connection between the two cells may be made by a more or less perfect conductor, such as wet tow, the human body, or moist earth,—the only rule to be observed being that the electro-motive power must be more than sufficient to overcome the resistance introduced into the circuit.

Mr. Wilde, in a lengthy paper in the last number of the *Philosophical Magazine*, has recorded an experiment of the same kind, on a Brobdignagian scale, and has arrived at results which he declines to explain in any such rational manner. His electro-motor, actuated by a 7-horse-power steam engine, has the energy of a lightning flash; his conductors are copper-wire ropes, half an inch in diameter and 140 feet in length; and his decomposing trough is a navigable canal.

In his experiments Mr. Wilde uses an electric current of enormous power, generated by means of the large electro-magnetic machine of his construction; the quantity-armature of which is capable of melting about fourteen inches of iron rod, a quarter of an inch in diameter, and the intensity-armature, seven feet of iron wire, 1-16th of an inch in diameter. The intensity-armature was used, and its currents were turned all in the same direction by means of a commutator.

It appears that the energy of Mr. Wilde's machine is sufficient to decompose water, when the resistance of 200 feet of moist earth intervenes between the terminals.

Three hundred feet of the naked copper rope were extended in one length in a canal, and connected with one pole of the electro-motor. The other pole, having a platinum terminal, was introduced into a pool of water 200 feet from the canal, and a eudiometer tube was inverted over it. Reasoning from small things to great it might be supposed that the electric current would decompose the water, oxygen going to one pole and hydrogen to the other. *And this, of course, is exactly what happened.*

Instead of explaining these phenomena in the usual manner, Mr. Wilde, after describing how twenty cubic inches of oxygen were collected in six minutes, says that these "represent the transmutation of 6·92 grains of water into the same number of grains of gaseous oxygen at the ordinary atmospheric pressure and temperature. On reversing the polar connections, so that the platinum now formed a negative electrode, twenty cubic inches of hydrogen were generated in three minutes, which volume of gas represents the transmutation of 0·43 of a grain of water into the same weight of gaseous hydrogen." The gases were obviously evolved in the proportions in which they enter into combination to form water.

The explanation is very simple, and will doubtless have already occurred to most of our readers. It is well stated by Dr. Francis, the editor of the *Philosophical Magazine*, in a note appended to Mr. Wilde's paper, where he says: "We are of opinion that the supposed conversion of water into oxygen or hydrogen is simply a decomposition of water, the oxygen being evolved in the one pool, the hydrogen in the other, *the earth acting as the conductor between the two pools.* The large surface of the conducting wire in the one pool would naturally make the amount of gas evolved at that pole appear very small."

Not quite so simple as this is Mr. Wilde's explanation. He gives what he is pleased to call his conclusions in the following phraseology: "When the positive or negative electrode of an electro-motor is plunged into a body of water in contact with the earth, it seems to me that the corpuscular motion of the electrode, by the very act of communicating itself to the molecules of water in immediate contact with it, transforms them into molecules of oxygen or hydrogen, the electric impulse (after leaving the electrode) being then received into the entire mass of the terraqueous globe by a physical conductivity similar to that by which the current is propagated in metallic bodies."

That no doubt may exist as to his opinions being very decided on one point, we need only quote the following expressions:—"In order that no reasonable doubt may be entertained that the oxygen or the hydrogen evolved from the electrode in the pool had no relation whatever to the oxygen or hydrogen liberated on the surface of the conductor extended in the canal, I will just add another observation"—Then he goes on to describe how a discharge of lightning fused a copper wire conductor, and assumes that had the end of this wire been immersed in water, the water would have been decomposed *solely* into hydrogen *or* oxygen, according to the positive or negative condition of the extremity of the wire connected with the water.

In a note to paragraph 207, Mr. Wilde quotes Faraday's *Experimental Researches* to prove that electricity of tension passing into water decomposes it solely into oxygen or hydrogen. His whole argument, as set forth in paragraphs 206, 207, and especially 208, falls to the ground, if the decomposition is not of this character, or if both gases are evolved simultaneously at one pole. Yet, on referring to Faraday's paper, we find that no such conclusion is warranted. Faraday describes a well-known experiment of Wollaston's, in which oxygen and hydrogen, mixed, were evolved from *each* pole. In his comments, Faraday writes as if he foresaw the use which Mr. Wilde would make of his name, and answers prophetically—"That the experiment should never be quoted as proving true electro-chemical decomposition is sufficiently evident, from the circumstance, that the *law* which regulates the transference and final place of the evolved bodies has no influence here. The water is decomposed at both poles independently of each other, and the oxygen and hydrogen evolved at the wires are the elements of the water existing the instant before in those places. That the poles, or rather points, have no mutual decomposing dependence, may be shown by substituting a wire, or the finger, for one of them, a change which does not at all interfere with the other, though it stops all action at the changed pole."—(*Phil. Trans.*, Jan. 1833, par. 328.) Extending Wollaston's experiment, Faraday subsequently found that, with frictional electricity, electro-chemical decomposition does not depend upon the simultaneous action of *two metallic* poles, since a single pole might be used, decomposition would ensue, and one or other of the elements become liberated and pass to the pole, according as it was positive or negative. His philosophical mind did not, however, lead him to jump to the startling conclusion to which a similar observation has beguiled Mr. Wilde, for Faraday goes on to say (*loc. cit.* par 461)—"In considering the course taken by, and the final arrangement of, the other element, I had little doubt that I should find it had receded towards the other extremity, and that the air itself had acted as a pole, an expectation which was fully confirmed in the following manner."

Mr. Wilde complacently proceeds—"That the evolution of electrolytic oxygen and hydrogen from water is an operation of transmutation, and not one of decomposition, was further shown by the converse experiment of the reconversion of oxygen or hydrogen alone into water." This converse experiment being simply the conversion of some of the above-described arrangements into a gas battery.

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[*] Experimental Researches in Magnetism and Electricity. Second series. By H. Wilde, Esq. § 4, On the Transmutable Nature of Water. *Philosophical Magazine*, Ser. 4, vol. 36, p. 106.

An author who admires Faraday sufficiently to copy the form of the *Experimental Researches in Electricity* in its arrangement of headings, sections, numbered paragraphs, repeated cross references, and painstaking minuteness in describing the details of every experiment, should remember also that this Great Philosopher said that the most difficult thing for a student of physical science was to conduct a satisfactory experiment; he should not quote authorities to prove one view when they really prove the opposite; nor should he adduce a very early suggestion of Davy in favour of the idea that water might be the ponderable basis of both oxygen and hydrogen, when Davy himself, as the result of an elaborate research carried out in order to ascertain the facts of the case, came to the conclusion that this, his first inchoate idea, was untenable. Even if the chronological order of discoveries bearing upon its nature had been inverted, Mr. Wilde ought to know that the recognised view of the atomic composition of water stands upon too firm a basis of chemical facts to be "summarily rejected at the present day," as he asserts it would be. But *Le style c'est l'homme.* It has cost us much painstaking to extract the author's meaning, so ponderous and obscure is his style, so lame and impotent his conclusions. Ungainly sentences of fourteen, sixteen, and even twenty-one lines of close type, undivided except by commas, constitute an onerous tax on the brain of scientific students. But the style fitly represents the perverse reasoning and confusion of thought which pervades this odd paper.

ON THE COMBUSTION OF HYDROGEN AND CARBONIC OXIDE IN OXYGEN UNDER GREAT PRESSURE.

By E. FRANKLAND, Ph.D., F.R.S., Professor of Chemistry in the Royal Institution, and in the Royal School of Mines[*].

In a former communication to the Royal Society,[†] I described some researches on the effect of a diminution of pressure on some of the phenomena of combustion, and deduced therefrom the law that the diminution in illuminating-power is directly proportional to the diminution in atmospheric pressure.

Further experiments, made more than a year ago, on the nature of the luminous agent in a coal-gas flame[‡], led me to doubt the correctness of the commonly received theory, first propounded by Sir Humphry Davy[‖], that the light of a gas flame, and of luminous flames in general, is due to the presence of solid particles. In reference to gas and candle-flames, it is now well known that the fuliginous matter produced when a piece of wire-gauze is depressed upon such flames, and the sooty deposit which coats a piece of white porcelain placed in a similar position, are not pure carbon, but contain hydrogen, which is only completely got rid of by prolonged exposure to a white heat in an atmosphere of chlorine. On pursuing the subject further, I found that there are many flames possessing a high degree of luminosity which cannot possibly contain solid particles. Thus the flame of metallic arsenic burning in oxygen emits a remarkably intense white light; and as metallic arsenic volatilises at 180° C., and its product of combustion (arsenious anhydride) at 218° C., whilst the temperature of incandescence of solids is at least 500° C., it is obviously imposible here to assume the presence of ignited solid particles in the flame. Again, if carbonic disulphide vapour be made to burn in oxygen, or oxygen in carbonic disulphide vapour, an almost insupportably brilliant light is the result. Now, fuliginous matter is never present in any part of this flame, and the boiling-point of sulphur (440° C.) is below the temperature of incandescence, so that the assumption of solid particles in the flame is here also inadmissible. If the last experiment be varied by the substitution of nitric oxide gas for oxygen, the result is still the same; and the dazzling light produced by the combustion of these compounds is also so rich in the more refrangible rays that it has been employed in taking instantaneous photographs, and for exhibiting the phenomena of fluorescence.

Many other similar cases of the production of brilliant light from incandescent, gaseous, or vapourous matter might be cited; but I will mention only one other. Amongst the chemical reactions celebrated for the production of dazzling light, there are few which surpass the active combustion of phosphorus in oxygen. Now phosphoric anhydride, the product of this combustion, is volatile at a red heat; and it is therefore manifestly impossible that this substance should exist in the solid form at the temperature of the phosphorus-flame, which far transcends the melting-point of platinum. For these reasons, and for others stated in the lectures above quoted, I consider that incandescent particles of carbon are not the source of light in gas and candle-flames, but that the luminosity of these flames is due to radiations from dense but transparent hydrocarbon vapours. As a further generalisation from the experiment above mentioned, I was led to the conclusion that dense gases and vapours become luminous at much lower temperatures than aëriform fluids of comparatively low specific gravity, and that this result is to a great extent, if not altogether, independent of the nature of the gas or vapour, inasmuch as I found that gases of low density, which are not luminous at a given temperature when burnt under common atmospheric pressure, become so when they are simultaneously compressed. Thus mixtures of hydrogen and carbonic oxide, with oxygen, emit but little light when they are burnt or exploded in free air, but exhibit intense luminosity when exploded in closed glass vessels, so as to prevent their expansion at the moment of combustion.

I have recently extended these experiments to the combustion of jets of hydrogen and carbonic oxide in oxygen under a pressure gradually increasing to twenty atmospheres. These experiments were conducted in a strong iron vessel, furnished with a thick plate of glass of sufficient size to permit of the optical examination of the flame. The results are so remarkable that, although still far from being complete, I venture to communicate them to the Royal Society before the close of the session. The appearance of a jet of hydrogen burning in oxygen under the ordinary atmospheric pressure is too well known to need description. On increasing the pressure to two atmospheres, the previously feeble luminosity is very visibly augmented, whilst at ten atmospheres' pressure the light emitted by a jet about 1 inch long is amply sufficient to enable the observer to read a newspaper at a distance of 2 feet from the flame, and this without any reflecting surface behind the flame. Examined by the spectroscope, the spectrum of this flame is bright and perfectly continuous from red to violet.

With a higher initial luminosity, the flame of carbonic oxide in oxygen becomes much more luminous at a pressure of ten atmospheres than a flame of hydrogen of the same size and burning under the same pressure. The spectrum of carbonic oxide burning in air is well known to be continuous; burnt in oxygen under a pressure of fourteen atmospheres, the spectrum of the flame is very brilliant, and perfectly continuous.

If it be true that dense gases emit more light than rare ones when ignited, the passage of the electric spark through different gases ought to produce an amount of light varying with the density of the gas; and this is in fact the case, for electric sparks passed as nearly as possible under similar conditions through hydrogen, oxygen, chlorine, and sulphurous anhydride emit light, the intensity of which is very slight in the case of hydrogen, considerable in that of oxygen, and very great in the case of chlorine and sulphurous anhydride. When liquefied sulphurous anhydride is sealed up in a strong tube furnished with platinum wires, and the temperature then allowed to rise until the internal pressure amounts to three or four atmospheres, the passage of induction-sparks through the enclosed gas is attended with very brilliant flashes of light. Further, if a stream of induction-sparks be passed through air confined in a glass tube connected with a condensing syringe, and the pressure of the air be gradually augmented to two or three atmospheres, a very marked increase in the luminosity of the sparks is observed, whilst on allowing the condensed air to escape, the same phenomena are observed in the reverse order.

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[*] Read before the Royal Society, June 11, 1868.

[†] Phil. Trans. vol. cli., p. 629 (1861).

[‡] Lectures on Coal Gas, delivered at the Royal Institution, in March, 1867. *Journal of Gas Lighting.*

[‖] Phil. Trans. for 1817, p. 75.

The electric arc from fifty cells of Grove's battery is incomparably more brilliant when mercury vapour, instead of atmospheric air, is interposed in the path of the discharge between the carbon points. The gases and vapours just mentioned have the following relative densities:—

Hydrogen	1·0
Air	14·5
Oxygen	16·0
Sulphurous anhydride	32·0
Chlorine	35·5
Mercury	100·0

It is obvious that the above results have a very direct bearing upon the views now generally held regarding the constitution of the sun, stars, and nebulæ; but I refrain from making any such application of them until I have the honour of laying before the Royal Society a complete account of these experiments.

ON A METHOD OF

ESTIMATING TARTARIC AND MALIC ACIDS

BY MEANS OF

IRON, ALUMINIUM, MANGANESE, &c.,

AND RECIPROCALLY.

By M. JUETTE.

Of all acids, tartaric and malic acids alone possess the known property of rendering iron, aluminium, manganese, &c., soluble in alkaline liquids.

Peroxide of iron in acid solution, not containing either tartaric or malic acid, is precipitated as soon as the liquid is neutralised by ammonia. If, on the contrary, iron and tartaric acid be mixed in determinate proportions, or if the tartaric acid be in excess, there will be produced, after saturation with ammonia, a tartaroferric ammoniacal composition of a fine red colour, soluble in acid or alkaline liquids provided they do not contain any of the oxides of the alkaline-earthy metals. The study of this phenomenon has led to a method of estimating either tartaric and malic acids with a standard solution of iron or aluminium, or of these same metals with a standard solution of crystallised tartaric acid. A given weight of pure iron is dissolved in nitric acid, which is then diluted with distilled water to form a standard liquid containing 0·001 or 0·002 of iron. If to a solution of 100 milligrammes of iron, 45·5 milligrammes or any larger quantity of tartaric acid be added, and also one or two cubic centimetres of common ammonia to render the liquid decidedly alkaline, the product will be, after vigorous stirring, a red liquid which is at first thick, but which, when left to itself, becomes and remains limpid. If, on the contrary, to 100 milligrammes of iron be added 45 milligrammes or more of tartaric acid, and then an excess of ammonia, &c., the liquid, at first thick, deposits the characteristic precipitate of peroxide of iron. The soluble compound produced by a proportion of tartaric acid equal to or exceeding 45.5-100 is permanent in the presence of acids, alkalies, and alkaline carbonates, provided they be exempt from lime, and also in the presence of ammoniacal salts, alcohol, ether, &c. If the compound be heated to ebullition the iron is almost entirely precipitated; this may also be done by adding to the liquid some hours afterwards ordinary water containing calcareous salts.

In practice, 0·455 grammes of the substance to be assayed are dissolved in acidulated water, which is then diluted with common water to form a determinate volume, such as for instance 100 cubic centimetres; 10 cubic centimetres are deducted, and, according as the matter contains 1, 2, 3, . . . *n* hundredths of tartaric acid 1, 2, 3, . . . *n* milligrammes of iron may be added, which will remain dissolved. Thus, in a simple manner, by two trials two different results are obtained, namely,

With *n* milligrammes of iron . . . , limpid solution.
,, $(n + 1)$,, ,, . . . , precipitate.

n is the number of hundredths of tartaric acid contained in the substance.

The estimation of tartaric acid in crystallised bitartrates and neutral tartrates gives to nearly 1-100 the proportion of tartaric acid indicated by the formula.

I was led to this method of direct estimation of tartaric acid by the necessity of estimating the value of the artificial tartrates of lime produced by the treatment employed upon the residue of the grape, and upon the weak vinegars from the distilleries, by my learned friend Dr. E. de Poutevès and myself during the last two years. The plaster residues of the south yield an average of 60 kilogrammes of rough tartrate, containing from 21 to 25 per 100, that is to say from 12 to 15 kilogrammes of tartaric acid. The tartaric acid from wine submitted to distillation is completely lost and mixed with the vinegar, from whence we obtain more than 5-10ths of the rough product sufficiently pure to undergo the ordinary process of extracting the acid.

In operating on wine or cyder, a quantity a hundred times greater is used for each trial by measuring 45·5 cubic centimetres, diluting the volume to 100 cubic centimetres, and deducting ten for each trial. Thus the number of 10·000, or the number of decigrammes of tartaric acid per litre, is obtained.

It is unnecessary to pay any attention to the colouring matter of red wines; the results are clearer if the lime has been precipitated. This preliminary operation is necessary in the analysis of cyder. Should tartaric and malic acid exist together in wine or cyder, the test will allow of their being estimated together as tartaric acid. This process permits the resolution of physiological enquiries relative to the variable quantity of tartaric acid found in the grape during maturation, and in wine manufactured at different ages, and also in diseases of which such variations are the symptoms. In order to reverse the operation, the iron is estimated in percentages by means of a standard solution of tartaric acid. 100 milligrammes will render 0·2197 grammes soluble. 2·197 grammes of the material are dissolved and the liquid diluted to 100 cubic centimetres; 10 are removed and the smallest number, *n*, of milligrammes of acid capable of dissolving the iron is sought for. This method when applied to crystallised sulphate of iron easily gives results within one per cent. Lastly, this process is applicable to all metals which, like iron, aluminium, manganese, chromium, &c., possess the property of insolubility in ammoniacal liquids except in the presence of determinate quantities of tartaric or malic acid.—*Comptes Rendus*, lxvi., 417.

CONTRIBUTIONS TO OUR KNOWLEDGE OF PERSULPHIDE OF HYDROGEN.

By Dr. A. W. HOFMANN, F.R.S.

Persulphide of hydrogen, first observed by Scheele, was afterwards examined by Berthollet; but our knowledge of this remarkable body is almost entirely due to Thenard,* who soon after the discovery of peroxide of hydrogen, submitted the persulphide to a detailed study. The composition of this body is, however, doubtful. Thenard only stated that the specimens examined by him contained sulphur in varying proportions, but always greater than what ought to exist in a sulpho-compound corresponding to peroxide of hydrogen.

If, therefore, some authors allow themselves to express the composition of persulphide of hydrogen by the formula—

$$HS_2,$$

either with or without a note of interrogation, they are going beyond what experience would warrant.

Certain circumstances have recently drawn chemists' attention anew to persulphide of hydrogen.

Amongst the novelties in technical chemistry which were made known at the Exhibition of 1867, none perhaps excited so much interest as those which by the most diverse methods sought to bring back for industrial purposes the masses of sulphur locked up in the mountains of soda residues. Chemists have especially admired the processes by which both M. Schaffnert or MM. P. W. Hofmann and P. Buquet succeeded in solving this problem.

In certain stages of the reactions on which these processes are founded, persulphide of hydrogen is often formed in large quantities, and quite recently, on visiting the manufactory at Dieuze, where sulphur is regenerated on an immense scale, I was able to procure several kilogrammes of this remarkable sulpho-compound.

This fortunate circumstance, by placing at my disposal considerable quantities of persulphide of hydrogen, allows me to throw some light on the composition of this product.

When a cold saturated solution of strychnine in strong alcohol is mixed with an alcoholic solution of sulphide of ammonium containing an excess of sulphur, brilliant crystalline flakes shortly appear in the liquid, and twelve hours later the sides of the vessel are covered with beautiful needles of an orange colour, which sometimes attain several centimetres in length. In order to obtain them in the state of perfect purity it is sufficient, after having decanted the mother liquor, to wash them with cold alcohol. These crystals are completely insoluble in water, alcohol, ether, and sulphide of carbon; indeed I have not succeeded in finding a solvent from which they can be crystallised.

Analysis of this compound led me to the following formula:—

$$C_{21}H_{24}N_2O_2S_3 = C_{21}H_{22}N_2O_2,H_2S_3.$$

The crystals are therefore a combination of one molecule of strychnine with one molecule of persulphide of hydrogen, the composition of which must therefore be expressed by the formula—

$$H_2S_3.$$

Indeed, the compound splits up according to the above formula. If the orange crystals are washed with concentrated sulphuric acid, they gradually decolourise with formation of sulphate of strychnine, which dissolves, whilst persulphide of hydrogen separates in the form of a colourless transparent oil. The drops of oil will keep for some time, but they gradually decompose into hydrosulphuric acid and sulphur.

The examination of this perfectly definite compound of strychnine and persulphide of hydrogen, which may be preserved for months without alteration leaves little doubt as to the existence of a persulphide of hydrogen—

$$H_2S_3,$$

which is therefore a sesquisulphide. It is, however, conceivable that there may exist other persulphides of a different composition.

The formation of the compound of strychnine just described, and which I have frequently made with the same success, led me to submit other alkaloids to an analogous treatment. Thus, I have examined the action of an alcoholic solution of sulphide of ammonium on quinine, cinchonine, brucine, and other vegetable bases, but in no case have I observed the appearance of phenomena similar to those seen when operating with strychnine.

The compound of strychnine with persulphide of hydrogen is remarkable for its insolubility. An alcoholic solution containing 2·03 grammes of strychnine being mixed with an alcoholic solution of sulphide of ammonium deposited, after twelve hours, 2·287 grammes of orange crystals, that is to say 87·2 per cent of the theoretical quantity. It remains to be seen whether this property of strychnine of forming so insoluble a compound with persulphide of hydrogen may not be utilised in the preparation of this alkaloid; and even in certain cases for its separation of substances with which it may be mixed.—*Comptes Rendus.*

ON

SOME OF THE CONSTITUENTS OF COAL GAS.*

A Lecture by Dr. ODLING, F.R.S., F.C.S., &c., before the British Association of Gas Managers, Tuesday, June 2.

(Concluded from page 41.)

Disulphide of carbon is a compound of great chemical interest, and I will now endeavour to illustrate to you some of its most striking properties. In the first place, it is a readily combustible substance—its carbon burning into carbonic acid gas, CO_2, and its sulphur into sulphurous acid gas, SO_2; but when burned with a deficient supply of air, a good deal of its sulphur escapes combustion, and separates as a deposit of yellow smoke. By warming a little disulphide of carbon in this flask I get an abundant supply of the vapour, which you now see burning with a fine blue flame, not unlike that of carbonic oxide. The flame is of very considerable brilliancy; and a piece of iron wire or watch-spring burns readily in it, with vivid scintillations and formation of sulphide of iron. Here, then, we have an illustration of the inflammability of disulphide of carbon in the state of vapour; and before calling your attention to the facility with which it assumes the state of vapour, I will just refer to the brilliancy of its combustion, both in oxygen and in the gas known as nitric oxide. With oxygen, however, the experiment is a dangerous one, from the violence of the explosion. In this jar of nitric oxide gas, then, I introduce a small quantity of disulphide of carbon, and, after shaking up the jar, apply a light to its mouth, when you will observe a large descending body of flame of surpassing intensity. This flame is very rich in chemical rays, and although lasting for scarcely an instant, is nevertheless applicable to the purposes of photography as a substitute for daylight. I will next give you an illustration of the facility with which the disulphide vaporises. At one end of this long shallow tray I place a piece of sponge wetted with disulphide of carbon. I now bring a lighted taper to the other end of the tray, at a distance of 3 or 4 feet from the sponge, and you observe that the vapour with which the tray is filled immediately takes fire; and I thus set fire to the sponge at a distance from it of several feet. The vapour of disulphide of carbon is very heavy—nearly three times as heavy as air. I have here a bottle of disulphide of carbon vapour, and here a succession of empty glasses. I pour the vapour from the bottle into a glass, from the first glass into a second, from the second into a third, and from the third into a fourth, and you see that in that fourth glass there is sufficient disulphide of carbon vapour left to take fire upon my bringing a light to it. The extremely low inflaming point of disulphide of carbon vapour is another point of much interest. I have here a little olive oil in a test-tube, which I heat over a lamp to the temperature of about 400°, although a lower temperature would suffice; and when I bring the extremity of the tube of hot oil near to the disulphide of carbon in this glass, you observe that it acts like a lighted match, and immediately inflames the vapour of the disulphide.

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* Thenard, *Ann. de Chem. et de Phys.*, xlviii., 79.

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With regard to the chemical nature of disulphide of carbon, it is an anhydrous sulphur acid, comparable, as I have said, with anhydrous carbonic acid. It unites with basic sulphides, including sulphide of ammonium, just as carbonic acid unites with basic oxides, including aqueous ammonia. Thus sulphide of carbon vapour, CS_2, is absorbed by sulphide of ammonium solution $(NH_4)_2S$, with production of sulphocarbonate of ammonium $(NH_4)_2CS_3$, corresponding to neutral carbonate of ammonium $(NH_4)_2CO_3$. When this sulphocarbonate of ammonium is exposed to the action of heat or of free ammonia, it loses sulphuretted hydrogen, and is converted at first into a salt called the sulphocarbamate of ammonium $(NH_4)NH_2CS_2$, and eventually into the sulphocyanate $(HN_4)NCS$, which is a tolerably stable compound. This sulphocyanate is also the principal product of the reaction of disulphide of carbon with free ammonia, as explained by the following equation:—

$$2NH_3+CS_2=(NH_4)NCS+H_2S.$$

With the fixed alkaline hydrates and sulphydrates, sulphocarbonates also are formed, which are, like the ammonia salt, unstable, but, unlike it, do not change into sulphocyanate. Availing ourselves of these reactions, disulphide of carbon may be removed from small quantities of gas by passing the gas through aqueous ammonia, or potash, or solution of sulphide of ammonium (gas liquor), or of sulphide of potassium or calcium (gas lime). But, owing to the insolubility of the disulphide in water, and its small proportion in the gas, its complete removal on the large scale by these means is quite impracticable, the impure gas having to remain for so long a time in contact with so large a surface of the absorbent, as I explained to you when treating of ammonia. The disulphide being soluble in alcohol, better results on a small scale are obtained by passing the gas through an alcoholic instead of a watery solution of potash. In this case the salt produced is not the simple sulphocarbonate of potassium, K_2CS, analogous to the carbonate, K_2CO_3; but it is the ethyloxisulphocarbonate, better known as the xanthate of potassium, $K(C_2H_5)CS_2O$, or $KEtCS_2O$. The solution of this salt gives a yellow precipitate with sulphate of copper, and a black precipitate with acetate of lead, especially on gentle warming. Another chemical property of disulphide of carbon is its reaction at a moderate heat with water, whether in the form of steam, or of a definite hydrate, as that of calcium (slaked lime). At about 400° a reaction of this kind takes place, though only imperfectly, with production of sulphuretted hydrogen and carbonic acid—

$$CS_2+2H_2O=CO_2+2H_2S.$$

As regards the products of the complete combustion of disulphide of carbon, I have already said that they are the carbonic and sulphurous acids. Now, sulphurous acid, which, in a greatly diluted state, is a very harmless substance, altogether different from sulphuric acid, is a constant product of the combustion of coal gas, and is derived from the presence in the gas partly of disulphide of carbon, and partly, it would seem, of other sulphur compounds of a similar nature. The proper mode of estimating the proportion of the sulphur existing in coal gas, in these different forms, is now, as you know, a subject of controversy. One party maintains that we ought only to estimate the amount of sulphur which, during the combustion of the gas from an ordinary burner, is converted into sulphurous acid—this sulphurous acid being regarded with great, though unwarrantable, alarm, from its possible conversion into sulphuric acid, which is alarmingly designated oil of vitriol. Now, if this estimation could really be made, it would, I am inclined to think, be perfectly sufficient; but as a matter of fact, it is quite impracticable to estimate the amount of sulphurous acid produced by the combustion of gas—burning the gas as it is ordinarily burned for purposes of illumination. When it is attempted to measure the amount of sulphurous acid produced by the combustion of gas, the gas is necessarily burned in a special manner, usually at the rate of about three quarters of a foot an hour, with a non-luminous flame, and under conditions which cannot be, or at any rate have not been, specially defined.

Another party, with which I confess that I am disposed to agree, says—"Take the bull by the horns, admit the worst, estimate by any efficient means the total quantity of sulphur contained in the gas, and declare it." Now, it is quite certain that if we take sufficient time and pains, we can estimate the absolute amount of sulphur existing in gas with reasonable certainty. But the Act of Parliament, having reference to the amount of sulphur indicated by the sulphurous acid formed in the combustion of the gas, as I have previously referred to, declares that the amount of sulphur existing in the gas in every form shall not exceed 20 grains in 100 feet. But this provision of the act is habitually and necessarily set at defiance. Not unfrequently the gas supplied in London furnishes, by its combustion, a quantity of sulphurous acid equivalent to slightly more than 20 grains in 100 cubic feet; and I think I may say that it almost invariably contains an absolute quantity of sulphur exceeding 20 grains in 100 feet, which, so far as I know, it is quite impracticable on the large scale to remove. What is the average amount of actual sulphur contained in London gas I cannot tell you, but I believe it is nearer 30 than 20 grains in 100 feet. I might here direct your attention to the very ingenious instrument devised by Mr. Valentin for making an absolute determination of the sulphur contained in gas, which gives much higher results than are furnished by Mr. Lewis Thompson's and Dr. Letheby's instruments. Mr. Valentin has kindly lent me the instrument for exhibition here this evening, and, being present, will, I am sure, be happy, at the conclusion of my lecture, to explain its construction to any gentlemen interested in the subject.

So far, then, I am a little at issue with gas managers in being disposed to admit that ordinary coal gas contains a greater amount of sulphur in some form or other than they are willing to allow, and than the letter, though not the spirit, of the Act of Parliament permits; for the Act was framed upon the results furnished by an incomplete combustion of the gas and condensation of the products. But, on the other hand, I am altogether at issue with the public, when they maintain that the sulphur of gas produces, by its combustion, oil of vitriol, or that the amount of sulphur ordinarily contained in gas is of any consequence whatever; and a little consideration will, I think, satisfy you of the soundness of this position. We will assume that coal gas contains, not 20, but 40 grains of sulphur in 100 feet—a quantity, at any rate, greatly exceeding the reality. Now, making another extravagant assumption, that the whole of these 40 grains of sulphur would be completely burnt—and in reality they would be burnt very incompletely—they would furnish by their combustion 80 grains of sulphurous acid gas. This quantity of the produced sulphurous acid would occupy at ordinary temperatures about 1-15th part of a cubic foot, and since 100 cubic feet of our coal gas give 1-15th of a cubic foot of sulphurous acid, 1500 cubic feet of coal gas would be required to furnish 1 cubic foot of the acid, even upon the extravagant assumptions we have purposely made. But the combustion of 1500 cubic feet of coal gas would produce something besides sulphurous acid. It would produce at least 1000 cubic feet of carbonic acid; and, in addition to its dilution by other gases and vapours, we should have our sulphurous acid diluted by 1000 times its volume of carbonic acid. Now, if we can get at the proportion of carbonic acid in the atmosphere of a room highly illuminated with gas, and take the 1000th part of that proportion, we shall be able to form some notion of the amount of sulphurous acid present. You will remember that the amount of carbonic acid furnished by the breath of one individual is equal to that furnished by two 3-feet gas burners, and that the maximum amount of carbonic acid found in the atmosphere of a crowded theatre was ·32 per cent. Now, if in addition to our previous unreasonable suppositions, we further suppose that an atmosphere contains ·2 per cent of carbonic acid furnished by gas combustion, you will see that the whole matter becomes a *reductio ad absurdum*—that we might actually have one half-millionth part of sulphurous acid present in the air of a gas-lighted room.

But this sulphurous acid is not sulphuric acid, and can only be converted into sulphuric acid with very much pains and difficulty, as all who have tried the experiment of converting the sulphur of coal gas into sulphuric acid are painfully aware. When gas is burned in special apparatus, indeed, its constituent sulphur can be converted into sulphuric acid; but it is very difficult to do this. The probability is that of the sulphurous acid produced in ordinary combustion scarcely a particle gets converted into sulphuric acid—certainly not more than the ammonia ordinarily existing in the atmosphere can neutralise, so as to form sulphate of ammonia instead of sulphuric acid; and with this conclusion, gentlemen, I bring to an end what I have to say to you respecting those constituents of coal gas which do not contribute much to its illuminating power.

SEWAGE EXPERIMENTS AT LEICESTER.

A short time ago we gave a brief account of some sewage experiments which had been tried by Messrs. Sillar and Wigner. So much curiosity has been excited by this account, and letters from correspondents enquiring for further particulars are so numerous, that we have thought it best to reprint the following account from the *Times* of Tuesday last:—

Some important experiments in the purification of sewage have been made at Leicester during the past week, and, indeed, are hardly yet concluded. The operations commenced on Tuesday; the members of the Royal Rivers Commission, Sir William Denison and Dr. Frankland (without Mr. John Chalmers Morton, who has not quite recovered from a slight accident), were present on Thursday, accompanied by the mayor and several members of the corporation of Leicester. Owing to unexpected difficulties which we shall presently explain, a prolongation of the trial was decided on, Dr. Frankland's assistant, Mr. Thorp, being appointed to watch the proceedings and take samples for analysis.

The object has been to put a new invention, the nature of which will be easily understood, to a practical test. The manurial matters in town sewage exist in a state of such attenuated solution that the weak liquid is valued at only twopence or a little more per ton; mere cost of conveyance, therefore, precludes its application to any but low-lying lands, and, as it cannot be stored for use except in certain seasons, it cannot be fully utilised except by some special system of husbandry capable of consuming one invariable quantity day by day throughout summer and winter. Hence, what a striking advantage it would be if we could separate the valuable constituents from the extremely diluted liquid, fixing them in a concentrated, dry, easily transportable manure worth several sovereigns per ton, that could be stored for use in any season and applied in any situation! Of the many plans proposed for accomplishing this feat, some have managed to separate the whole of the insoluble or sedimentary matter, and even a small proportion of the soluble constituents; but hitherto no chemical or mechanical device has succeeded in precipitating in a solid form the most valuable ingredients held in excessive dilution in the sewage. Everybody seemed to have agreed that the only feasible mode of utilising sewage is by surface irrigation. Inventors, however, are a class of people seldom found to relinquish a problem as hopeless; and little more than a month ago a new process for accomplishing the desired result was patented by Mr. Robert George Sillar (of the firm of W. C. Sillar and Co., bullion brokers, Cornhill), and Mr. George W. Wigner, analytical chemist, Grove-lane, Camberwell. The origin of inventions is often very curious; the present one is said to have been suggested, strangely enough, by some of the purifications enjoined upon the ancient Hebrews, "the ashes of a heifer" pointing out animal charcoal, and blood poured upon the ground prompting a use of blood and of clay. The inventors, therefore, mixed these three substances,—animal charcoal, blood, and clay,—adding alum and three other chemicals which are at present secret, but affirmed to be cheap and commercially obtainable in any quantity. Laboratory experiments showed that this "A B C compound," as it was called, had the power of precipitating nearly all the manurial constituents of sewer water, the whole settling in a flocculent mass at the bottom of the vessel in the course of a few minutes. The water was left almost pure, and the residuum when dried required only simple treatment by an acid to render soluble certain of the constituents for the use of plants. Of course, until further inquiry is made, and until the Rivers Commission authorise a publication of their own analysis, the inventors are responsible for these statements.

On the 16th of June a practical trial was made at Tottenham, where the Local Board of Health, being restrained by an injunction from pouring their sewage unpurified into the river Lea, are endeavouring to ascertain which is the most efficient and least expensive mode of purification. As reported in "*Engineering*" of July 3, a tank was filled with 5,000 gallons of very black sewage, a quantity of the A B C compound in solution was pumped in, and the water settled clear in twenty minutes, being so clarified and deodorised as to be free from smell and nearly tasteless. A larger tank was gradually filled with 36,000 gallons of sewage, admitted at the rate of about 1,000 gallons per minute, the solution running in at the same time, and in twenty minutes after the tank was full the precipitation had been effected and the water was clear. According to the inventor's analysis the water retained only one-eighth of the organic or dangerous impurities; and no less than 85 per cent of the ammonia and all the phosphoric acid (the two most valuable constituents) were removed from the sewage and fixed in the solid residuum. The 36,000 gallons of sewage yielded 8 cwts. of air-dried manure containing 20 per cent of organic matter, 2·37 per cent of ammonia, and 5·33 per cent of phosphoric acid. Mr. Wigner valued it at £2 3s. per ton; but it contained 68·5 per cent of silica, alumina, and various salts, and nearly half of this has been now removed by an easy process, leaving the manure worth so much more. The cost of the A B C compound in this experiment is stated to have been only 7s. 2d.; while the manurial product was valued at about 17s.

The Leicester trial is on a much larger scale, the mayor and corporation, at the request of the Rivers Commission, having placed their sewage works and machinery at the disposal of the inventors for several days. The drainage of this, probably the very cleanest and best kept manufacturing city of 90,000 inhabitants, is discharged into the river Soar at the rate of more than 4,000,000 gallons per diem, being lifted by two pumping-engines of twenty-two horse power each, at the Abbey-lane sewage works, about a mile north of the town. Here a company expended a great many thousands of pounds in carrying out Wickstead's milk of lime deodorising process; finally handing over the present extensive buildings, tanks, machinery, outdoor drying vats, &c., to the Leicester corporation, who now use them. Milk of lime is mixed with the sewage, which is thus partially deodorised before flowing into the river, while the offensive black sediment, drawn from the beds of the settling tanks by horizontal screws and elevators, is drained and air-dried in embanked compartments, and then sold (to a very limited extent) to farmers at 1s. per cartload.

Visiting the works on Friday we found the lime process going on in one-half of the establishment, while the other was devoted to Messrs. Sillar and Wigner—that is to say, one of the pumping engines and two of the great tanks were employed as usual, while the other engine and two tanks, holding 417,000 gallons at once, were occupied in the new process. The engine works two pumps, the large one delivering about 100,000 gallons of sewage per hour into a first or receiving tank, the smaller pump at the same injecting into the sewage about 1,000 gallons of the chemical solution, this entering the side of the huge pipe which leads from the sewage pump to the receiving tank. The agitation in the first or receiving tank causes a partial mixture; but a complete churning and intimate union are effected by the sewage passing through a number of small apertures into cells, in each of which revolves a stirrer, and thence out of the cells into two very spacious settling tanks. An artificial dam of bags of earth had been constructed to divide the receiving tank; this was frequently breached by the wash of the in-flowing sewage, thus mixing a portion of the lime-sewage with the other, and so vitiating the experiment, and fair specimen samples could not be taken until a sufficient time had elapsed after a repair of the dam. The chambers which supplied the smaller pumps had also been divided, so that one pump could be fed with milk of lime and the other with the A B C solution, and, unfortunately, a leakage made some difficulty here. Worse than this, it was found that the dry granulated clay used in the compound (which was all mixed on the spot) contained some small gravel, and several times this got into the pump valve and deranged the action of the pump, stopping the injection of the solution, while the pumping of the sewage continued. Long delays were occasioned; and of course no fair sample of the effluent water discharged from the tank into the river could be taken until the charge of sewage in the tanks had been completely renewed. Hence the trial was to be continued until Monday, Aug. 3rd, On Friday we did observe that the water passing over at the exit end of the great tank was clearer than that from the lime process, and that any odour from it was less perceptible. We found that the sediment from the new process had little smell, while that from the lime process was horribly offensive. We saw test-glasses full of the sewage precipitated in two or three minutes and made perfectly clear and sweet. We were informed that on the previous days, when the pump and the artificial tank walls were in order, the following average, but not corrected, results were obtained:—An imperial gallon of the sewage as it comes from the main culvert contains 130·2 grains of inorganic matter and 58·8 grains of organic matter; total, 189 grains per gallon. After the lime process the purified sewage-water contains 89·7 grains of inorganic and 42·7 grains of organic matter; total, 132·4 grains per gallon. But after the new process the purified sewer-water contains 43·3 grains of inorganic and 14·2 grains of organic matter; total, only 57·5 grains per gallon. We believe that London drinking water commonly contains 8½ grains of organic matter per imperial gallon; that is more than half the quantity left in this purified sewage, which must, therefore, be quite innocuous. The following is an approximate analysis of the air-dried residuum or manure which the new process has removed from the sewage at Leicester:—

Water	8	per cent.
Organic matter	36	"
Phosphoric acid..	4	"
Sulphate of lime	1	"
Alumina	9	"
Silica	39	"
Iron, loss, &c.	3	"
	100	
Ammonia	3½	"

This is considerably richer in ammonia than the Tottenham manure, which was valued at £2 3s. per ton; in fact, reckoning ammonia at £60 per ton, and the phosphoric acid (from its equivalent in phosphate of lime) at £50 per ton, the Leicester sewage manure, by the above analysis, is worth £4 per ton. These analyses were made by Mr. Wigner, the inventor, and are open to correction, or to exposure from the official analyses that will be made by Dr. Frankland.

We are told that the actual cost of the A B C compound used at Leicester has amounted to 8s. 7d. for each 100,000 gallons of sewage treated, whence the cost of materials for purifying the whole 4,000,000 gallons of sewage daily furnished by the town would be £17 3s. The alum, the clay, the animal charcoal, and the three unknown chemicals are all procurable (so we learn to any extent; and the blood used is only one pint to each 20,000 gallons of sewage, so that the daily consumption for Leicester would be 25 gallons.

The manure left as a black semi-fluid mud at the bottom of the tanks has yet to be removed by the worm-screw and dredge-elevators, and its quantity ascertained. But if it be true that of 189 grains of ingredients in each gallon of sewage 57·5 grains go away in the clarified water, 121·5 grains from each gallon of sewage must either remain in the precipitated residuum, or be dissipated into the atmosphere. At Tottenham, 40,000 gallons of sewage are reported to have yielded 8 cwts. of dried manure; and at this rate the 4,000,000 gallons of Leicester sewage should give 40 tons of manure per day, worth (as we have valued above) about £4 per ton. A return in manure of £160 per day for an outlay of £17 3s. in chemicals must leave a margin for huge profit, after paying any conceivable working expenses, and the interest upon buildings and machinery necessary for conducting the process.

The Leicester experiments are not yet completed, but we have said enough to show the importance of the pending inquiry, whether this new invention really is a marvellous boon to the world, or whether the whole is an illusion or a sham.

FOREIGN SCIENCE.

PARIS, AUG. 5, 1868.

Vesuvius.—The Sewage Experiments at Clichy. ACADEMY OF SCIENCES:—Rotatory Magnetic Power of Thallic Alcohol.—Laws of Induction.—Thermorheometer.—Artificial Production of Pyroxene and Peridote.—Action of Iodine on Arseniuretted and Antimoniuretted Hydrogen.

SEVERAL investigations have been made within the past six or eight months on Vesuvius. M. Deville communicated M. Palmieri's letters to him, under the title of "Facts concerning the History of the Eruption of Vesuvius," to the Academy. M. Franco likewise gives an account of an excursion to the crater of Vesuvius, on the 21st February, 1868; and, lastly, we have the researches of M. Silvestri, professor of chemistry in the University of Catania. In one of his letters, M. Palmieri remarks that on the east base of the cone, a crack of about 400 metres in length had opened. From two places in this crack an abundance of lava flowed, descending on to the territory of Bosco-Reale, superposing the lava of 1850. This current flowed with marvellous rapidity, without violence, without projectiles; it ceased to flow at the end of seven days, when it reappeared at the summit of the Vesuvian cone. The whole of the fissure, at the outpouring of the lava, presented a series of fumeroles, which, in the neighbourhood of the actual vents, evolved sulphurous acid, and farther off, the vapour of water alone, or with carbonic acid. When the activity of the eruption permitted, M. Palmieri, with his assistant M. Franco, made the ascension of the cone, and examined the emanations from various currents of lava issuing from the base of the cone of eruption; they found carbonic acid. In the fumeroles near the cone in eruption, and near the point whence the lava issued, abundant sublimations of chloride of iron were noticed; no traces of chloride of iron were found on the fumeroles from which the lava issued at the base of the Vesuvian cone, where the products were the chlorides of copper and lead. Upon aspirating the gas from a fumerole situated near Crocella, and passing it into a solution of chloride of barium, an abundant precipitate of sulphate of baryta was caused. Sulphates were found in this fumerole and in others. In another letter, M. Palmieri disputes an observation made by M. Silvestri—namely, the acidity of the fumeroles with the lava still flowing, or which are in their first period of existence. He affirms that the vapours from lava in motion give neither acid nor alkaline reaction. M. Silvestri states that the lava from this eruption presents itself, as usual, in every variety of form—as compact lava, scoriæ, and ash or sand; the scoriaceous form predominating. This lava is dark grey coloured, nearly black, sometimes reddish on the surface. Dark green tints are met with in the lava which has cooled rapidly, and is found in small blocks; the colour is that assumed by pyroxene, one of the principal constituents of lava. The reddish tint appears to be due to the further oxidation of the iron compounds in the lava. It is possessed of crystalline structure, owing to the presence of augite and leucite. The following are the densities of the different varieties of lava at 14° C.:—Sand, 2·786; scoriæ, 2·467; black compact lava, 2·819; greenish compact lava, 2·67; vitrified compact lava (after artificial fusion) 2·698. In placing these results obtained for the lava from the last eruption of Vesuvius with those obtained for the last eruption of Etna, which occurred in 1865, the only difference worthy of note observed is that while the compact lava from Vesuvius, after artificial fusion, has a density of 2·698; that from Etna, after the same treatment, had a density of only 1·972. The lava from Vesuvius is slowly and incompletely attacked by the strongest mineral acids, excepting hydrofluoric acid. M. Silvestri therefore made the analysis by fusion with pure lime, according to Deville's method. The compact lava gave the following results:—Silica, 38·888; lime, 17·698; alumina, 14·127; magnesia, 3·333; protoxide of iron, 12·696; manganese, ·01; potash, 1·19; soda, 10·0; water, 2·065. The amount of soda is very remarkable. The concluding portion of M. Silvestri's memoir, concerning the sublimates and the analyses of them, has already been noticed in Foreign Science.

Interesting experiments regarding the employment of sewage have been made on the Clichy territory, a little distance from the mouth of the Seine. The chemical separation of the matters operated upon, and the direct distribution, without previous purification, have been the two processes experimented with. According to a report of the engineer, M. Mille, charged to conduct the necessary trials, the chemical operaion results from a determinate proportion of sulphate of alumina, which precipitates the matters in suspension and causes the clarification of the water. The expenses of the operation assume very small proportions when account is taken of the yield—19 francs per ton for the precipitate, which constitutes an excellent manure, and 5 centimes per cubic metre for the clarified liquor. The total expense for this first process of purification is 2 centimes per cubic metre of sewage treated chemically. The other process, that is to say the direct distribution, has given, since 1867, very good results. Thus fertilised, the culture of the maize, or Indian corn has furnished a yield of 11,000 kilos. the hectare, and from beet-root plantations, 30,000 kilos. to the hectare, have been obtained. At the Universal Exhibition of 1867, the monstrous bulbs from the experimental plantation at Clichy attracted considerable notice. The jurors charged with the examination of these products, testified that their size in no way detracted from their quality, and that their taste was not affected by the manure to which they owed their development. The quantity of sewage water supplied in the culture did not exceed the amount of irrigation practised by the grower on the soil previously charged with manure. The experiments commenced at Clichy are about to be carried out in the plain of Gennevilliers on a much larger scale, which will doubtless hasten the solution of this important problem.

The following memoirs of chemical interest were communicated to the Academy at the meeting on July 6th. "On the cause of the great Rotatory Magnetic Power of Thallic Alcohol," by M. de la Rive; "On the Laws of Induction," by MM. Jamin and Roger; "On a Thermorheometer;" "On a Submarine Lamp supplied with Oxygen without Exterior Communication," by MM. Léauté and Denoyel; "Artificial Production of Pyroxene and Peridote," by M. Lechartier; "On a new Alkaloid isomeric with Toluidine contained in Commercial Aniline," by M. Rosenstiehl (already translated in full); "New Researches concerning the action of Hypochlorous Gas on a mixture of Iodine and Acetic Anhydride," by M. Schützenberger; "Action of Iodine on Arseniuretted and Antimoniuretted Hydrogen," by M. Husson.

Pyroxene and peridote are produced under many circumstances. Ebelmen obtained them in submitting certain mixtures of silica, magnesia, and boric acid to the prolonged action of a high temperature, and a subsequent very slow cooling in a porcelain furnace. M. C. St. Claire Deville, while studying the action of alkaline chlorides and sulphates on the metamorphism of sedimentary rocks, showed that a silicate might be transformed into a crystalline substance, having the composition and the density of pyroxene. M. Lechartier has prepared all the varieties of pyroxene and peridote; the following artificially-prepared compounds were found to be identical with the natural crystals, by their crystalline form, their density, and composition. Wollastonite $(CaO)SiO_2$, density 2·85; pyroxene, with lime and magnesia for bases $(CaO,MgO)SiO_2$, $D=3{\cdot}4$; pyroxene, with lime, magnesia, and protoxide of iron for bases $(CaO,MgO,FeO)SiO_2$, $D=3{\cdot}3$; pyroxene, with lime, magnesia, protoxides of iron and manganese $(CaO,MgO,FeO,MnO)SiO_2$, $D=3{\cdot}35$; peridote $(MgO)2SiO_2$, $D=3{\cdot}19$; peridote, with magnesia and protoxide of iron $(MgO,FeO)2SiO_2$, $D=3{\cdot}22$. The silica, intimately mixed with the oxides to which it is to be united, is placed in a crucible of gas retort carbon with anhydrous chloride of calcium broken in small pieces. The carbon crucible, furnished with a cover, is enclosed in an earthen crucible, and the space between the two filled with charcoal powder; the earthen crucible is then closed with its cover, which is carefully luted, and only a small opening left. The mixture is heated to bright redness for an hour or two. The temperature requires to be more intense and more prolonged for the production of peridote, than pyroxene; it is lower for ferruginous silicates than for the corresponding silicates which only contain lime and magnesia. The cooling is allowed to take place in the furnace. At the bottom of the crucible a button is found, containing the crystals of silicates disseminated in chloride of calcium; the latter compound being dissolved by water, the crystals are set at liberty. For pyroxene the following proportions are used:—Silica, 10 grms.; lime, 4; magnesia, 3; chloride of calcium, 100; 3 or 4 grammes of transparent colourless crystals, from 6 to 10 millimetres in length, are obtained. In the preparation of pyroxene, the lime can be replaced by anhydrous fused bisulphate of soda, and the magnesia by sulphate of magnesia. Peridote is prepared by heating 4 grammes of silica with 8 of magnesia and 100 of chloride of calcium. Colourless transparent crystalline plates are obtained; they are soluble in acids, and although crystallised in the midst of chloride of calcium, they contain not a trace of lime.

Ammonia, in presence of iodine, gives iodide of nitrogen. Not less easily, M. Husson states, antimoniuretted hydrogen and arseniuretted hydrogen form iodide of antimony and iodide of arsenic, when the two gases are made to pass over iodine. The ease with which the combination takes place may furnish a useful application in toxicological researches. A tube containing a small piece of iodine being joined to the Marsh's apparatus, gentle heat is applied to volatilise the iodine, which, upon condensation, lines the tube. Then, while the tube is still slightly warm, the gas is allowed to pass. If this contains arseniuretted hydrogen, the iodine will be bordered by a yellow line formed of little straw-like masses, having much analogy with iodoform; the iodine disappears completely. With antimoniuretted hydrogen the reaction is less manifest; all the iodine collects, forming a deep ring, orange-tinted on the one side and brown on the other. But the action of heat enables these two iodides to be distinguished thus:—The yellow iodide of arsenic is transformed, one part into red iodide with disengagement of iodine, the other volatilises in the state of yellow vapours which are received on unsized paper; the same phenomenon is produced under the influence of an excess of arseniuretted hydrogen, whence M. Husson is inclined to conclude that a periodide of arsenic, AsI_5, is first produced. Iodide of antimony, on the other hand, evolves red vapours, and leaves a little reduced antimony.

NOTICES OF BOOKS.

Intercolonial Exhibition, 1866-67. *Official Record. Melbourne, Australia.*

This official record is chiefly a collection of the reports and awards of the jurors. The reports we may mention were furnished gratuitously, and they contain evidence of very careful preparation. The interest taken by everyone in regard to the exhibition is somewhat odd to us in England: railway companies, shipping companies, and carriers allowed packages and cases to pass free of expense, even analyses were made gratis, and indeed, reading these introductory portions, one begins to doubt whether in the old country we are not moving towards dignified eastern apathy.

A considerable part of the volume is devoted to a description of minerals found in the colony and exhibited. Probably the reports we first encounter are those relating to the exhibits most connected with chemistry. The first is "Mineral Products; Class 1, Section 1." Among the gold specimens exhibited was an ore containing gold, with sulphides of nickel and silver, in iron pyrites from South Australia. A specimen of black oxide of copper crystals from Western Australia is noteworthy, on account of the form of the crystals, viz., rhombohedral, the hardness being 3. The crystals possess great lustre, and resemble iron glance in general appearance. The Murninnie Mining Company exhibit a good collection of bismuth ores and metallic bismuth in ingots. Two specimens of earthy cobalt containing 8 per cent of cobalt, were exhibited, as well as an ingot, containing 64 per cent of copper and 28 per cent of cobalt, obtained by Thomas and Co's patent method of extracting cobalt from its ores. Coal was exhibited by the Mining Department of Victoria; an examination or the quality gave volatile hydrocarbons 31·74 per cent, fixed carbon 24·75 per cent, ash 43·51 per cent. Some very fine blocks of limestone, yielding upon analysis 95·5 per cent of carbonate of lime, were exhibited; there were likewise from Victoria, good sandstone, Fuller's earth, and granite. Among the gems and precious stones collected in the colony, there were diamonds, sapphires, topazes, garnets, spinels, and tourmaline. From New South Wales very fine specimens of coal were exhibited: also kerosene shale and the oils obtained therefrom. Tasmanian coals were also exhibited and analysed; the amounts of ash in four varieties were respectively 8, 10, 16, and 20 per cent. Graphite, but not very pure, was exhibited from New Zealand.

In the introduction to Section 2, Class 1, devoted to chemical and metallurgical products and processes, the jurors remark "In the vegetable kingdom, new species "and even new varieties, will afford new resins, new "essential oils, new alkaloids, new barks, and vegetable "acids, and oft-times on the other hand they become new "sources of well-known and useful vegetable products. The "present Exhibition affords an example of this latter case, "in which the grass-tree (*Xanthorrhea Australis*) is made "to yield alcohol, varnishes, and picric acid." After an exposition of the dependence of chemical manufactures, the jurors point out the great natural resources of the Australian colonies. At the outset there is no scarcity in fuel; then there is native sulphur in New Zealand, and iron and copper pyrites as a source of sulphur in Victoria and other places, ores of copper, lead, and bismuth, and probably cobalt also, are well provided in South and Western Australia, and of tin ore there is no lack either in quantity or quality. Iron ores are abundant everywhere; the magnetite of Tasmania contains 70 per cent of metal. We learn that chemical manufactures may be said to have already a fair existence, since the reporters remark that Melbourne vies with Sydney in the manufacture of oil of vitriol and other mineral acids, on a creditable scale. Samples of carbonate of soda and silicate of soda of Melbourne make were also exhibited.

The soap manufacture was represented by samples of great excellence. To quote from the report indeed this manufacture appears to have developed to a tolerably advanced state; "It includes, among other examples, the excellent silicated soap of Messrs. Gossage, Brothers, which may be mentioned as presenting the most modern phasis of the soap-maker's art, and which with colonial-made silicate and carbonate of soda exhibited by that firm, are of very high chemical interest, and deserving of unqualified commendation." In pharmaceutical chemistry there were not many exhibitors, but several of the exhibits, such as the granulations of the chalybeate salts, scale preparations of iron, quinine, and ammonia, are mentioned as deserving of notice. Likewise a collection of chemicals, and especially a fine crystal of nitrate of silver, prepared in the colony. One firm, in addition to the general exhibits, showed a series of products obtained from the grass tree resin, viz., distilled spirit, picric acid, the resin, and a sample of polish made from the latter, as well as a specimen of wood stained with the acid. Photographic chemicals were exhibited by one or two firms; the collection was considered good.

These are, perhaps, the only two sections relating entirely to chemical operations, and we now turn to a few subjects, possibly interesting to our readers, distributed in different parts of the volume.

An ingenious filter was exhibited by Dr. de Bohn, to whom a medal was awarded for this exhibit. The filter consists of two cylinders of copper, the one filled with porous stone, and the other with charcoal or other chemically-purifying material, the cylinders being connected by a short pipe and union. With a moderate pressure, this apparatus filters very rapidly and effectually; it can be easily cleaned by reversing the cylinders end for end, and passing a good current of water through. The filter was constructed with a special view to clear wine in process of maturing from the minute organisms which give rise to acetous fermentation and other changes. The wine-growth we may perhaps notice, if only to draw attention to its dimensions, the quality of a really large number of samples from many growers being declared of excellent quality.

We had intended to notice the paper-making materials; we will, however, merely remark that the manufacture of paper from the New Zealand flax (*Phormium tenax*), a fibre already known in Europe, is being now fairly started in the Australian colonies.

CORRESPONDENCE.

ON SCIENCE TEACHING IN SCHOOLS.

To the Editor of the Chemical News.

Sir,—The very excellent article in your last week's paper, by Mr. Rodwell, on the above subject, exhibits, towards its close, a certain amount of hesitation, as though he were afraid of having committed himself to a too liberal programme, and asserts as an apology for the old *régime*—"But even if he learnt nothing of ordinary book-work, he learnt much that forms part of a liberal education—a gentlemanly tone and character;" a certain *esprit de corps*, &c.

I ask, are these recommendations inherent to the study of Latin and Greek? Do we find men, who, without ability to become great classical scholars, have passed through the Universities, and completed their curriculum, any less qualified to take their stand in the world as gentlemen, or wanting in the superficialities above referred to, than those who have obtained high classical honours?—Often the contrary.

To say the truth, the majority of those who are educated at college leave it with a very imperfect acqaintance with those languages which they have spent years in professing to acquire; and again, if we compare the sum of knowledge which the works of antiquity convey with that conveyed by modern, the disproportion is great in the extreme.

The consequences of the system which has hitherto prevailed are undoubtedly that a young man, in by far the majority of instances, has to set about gaining knowledge of a totally different kind, and to practically forget his previous learning when he has to commence his professional life.

But the children of the middle classes do not learn these dead languages: they do not, in nine cases out of ten, acquire them so as to appreciate the merits and beauties of ancient literature. Ask any of them if they could hold half an hour's conversation with Cicero, if now living; or, can they read and enjoy his writings as they do those of Addison? Yet, unless a man does learn a language so as to be able to converse in it and understand it, or at least to read it, with perfect facility, how is it to be a means of elevating the taste? Playfair, in his enquiries as to the causes of decline of nations, concludes that in ordinary boarding schools, "not above one in a hundred learns to read even Latin decently well—that is one good reader for every ten thousand pounds expended"; and thus day after day and year after year is spent upon "*Hic, hæc, hoc*," "*Propria quæ maribus*," "*As in presenti*," "*et* (and), *cum* (when)," and the like, to make a man of cultivated taste.

As a further incentive to the study of the dead languages, we are asked to admire the "veneration of all that is ancient, that intense admiration for the patriotism and valour which in former ages ennobled dynasties and raised mere specks upon the earth's surface into powerful states governing half the world;" in our schools we imbibe these influences, and carry them to the grave. That the patriotism and valour of the old Greeks and Romans is well worth studying I do not deny, but that it is desirable for all boys, as the rule now is, to learn to read of it in the Greek or Latin language I do deny—French, German, or even English translations would convey the spirit of it equally well.

Further on, Mr. Rodwell states that he sees "nothing elevating or improving to the intellect in the knowledge of the modes of utilising tar liquor or of dyeing calico." In this I beg entirely to differ, and think the majority of the readers of the Chemical News will do the same. Is there nothing to elevate a man in the study of the beautiful laws of chemistry, which must be understood before the nature of the constituents of even coal tar can be learnt?

But if chemical knowledge is to be treated in such a matter-of-fact way, let us for a moment consider how the learning of "The Learned" will bear it. Of what avail is it to elevate or improve the intellect to read of the loves of the heathen gods in a language which expresses the sentiment "I love," by the word *amo*, and which has been entirely disused for many centuries. The fact is, human knowledge is so much more extensive than the opportunity of individuals for acquiring it, that it is of immense importance, so to economise the opportunity, as to gain as large and valuable a portion as we can. "Let the dead" languages "bury their dead." The English language possesses a sufficient store of literature without wasting time over others simply to increase it.—I am, &c.,

A. L. Steavenson.

DEATH BY CARBOLIC ACID.

To the Editor of the Chemical News.

Sir,—My note on the 10th ult. having given pain to the friends of the late Mr. Berger, in consequence of my saying, without qualification, that he must have drunk carbolic acid, please allow of this trespass, in explanation.

Dr. Metcalfe, who made the *post mortem*, says, in the *Lancet* of the 18th ult.,—"The death arose from asphyxia, or, speaking more correctly, from apnæa, doubtless from some of the acid getting into the larynx, simultaneously with the stomach."—The jury returned a verdict of "accidental death, arising from *inhaling* carbolic acid, as a cure for the tooth-ache."

The object of my note was to correct this important error, and to show that the unfortunate gentlemen must, accidentally, have *swallowed* the fluid—that death thus resulted, and not from its inhalation, as the verdict records.

The letter of Dr. Metcalfe now confirms this. Mr. Berger, obviously intended to *inhale* the vapour only, through the long tube—this would, most probably, have given him the relief sought, as it has done others; but if, while in his agony, he unduly exerted himself to inhale a full dose (which is very likely), and if by accident the "large jar" of fluid was upset (not at all unlikely with such a length of tubing attached), he might easily have taken in more than a sufficiency of the fluid to cause asphyxia and death.

No one, I think, can infer from the facts now published that the unfortunate gentleman (excellent as he was talented) intended suicide: for had this been his intention, he would neither have used such a clumsy apparatus, nor would he have selected carbolic acid.—I am, &c.,

T. A. Readwin.

108, Dorset Street, Aug. 5, 1868.

MISCELLANEOUS.

Carbolic Acid, a Cure for Snake Bites.—Messrs. F. C. Calvert and Co. have forwarded us a letter they have received from John W. Hood, B.Sc., M.D., of Melbourne, Australia, from which we make the following extract:—"An unfortunate experiment, resulting in the death of the principal performer, as to the efficacy of a so-called antidote for snake bites, took place here some few weeks since, and of which I send you a report. The cure of persons bitten by the venomous snakes of Victoria has long been a favourite subject for experiments among the medical profession here. I, living in a city, have not the opportunity of meeting with any human subjects to experimentalise upon, and have to rest contented with quadrupeds—most of which suffer death. However, I have long entertained the opinion that carbolic acid, taken internally and used as a caustic to the wound, would be found to be beneficial, and, perhaps, a specific cure. That I am right, to a certain extent, is proved by the fact that a friend of mine, a medical man living at Warrnambool, Dr. Boyd, successfully treated two cases of snake bite with carbolic acid. I am not aware of more particulars than that the first case was a young lad bitten by a tiger-snake, the most venomous these colonies produce, and Dr. Boyd—six hours after the boy was bitten—administered ten drops of pure acid, in brandy-and-water, every few minutes. He writes—'the effect was magical—from a pallid countenance, slow pulse, and semi-comatose condition, the patient rallied to a bright expression, ruddy glow, and quick pulse, and the recovery, though slow, was continuous and certain.''

The Temper of Modern Science indirectly rules the progress of the healing art. It is of consequence to appreciate what that temper is. It would be difficult more aptly to describe it than by the words of Newton:—"The main business of natural philosophy is to argue from phenomena without feigning hypotheses, and to deduce causes from effects, till we come to the very first cause, which certainly is not mechanical." This phrase suggested to one a countless host of loving worshippers, to another a crowd of stern inquirers, each in his own sphere, tinged with the special hue of his own nature; in physics and biology all alike are searching for a true cause. From the causes of twining in the delicate tendril to the causes of variation in the human species, from the causes and local conditions of atmospheric changes, to the causes and physical consequences of the combustion of a fixed star, the biologists and astronomers of the day are seeking a true cause. And each in his way, appreciated by hundreds of fellow-workers and ten thousands of more or less intelligent followers, is making a step towards the first cause, which, Newton says, "is certainly not mechanical." And what have they reached? The generalisation, at once so simple, so overwhelming, that all action of which we are immediately cognisant is but the result of the operation of solar heat upon and through interdependent and correlative existences; that all things in this system are capable only of interchange; that there is no destruction of what exists, no creation of new energy.—*Dr. Acland. Inaugural Address before the British Medical Association*, Aug. 4. 1868.

The Fire at Newcastle.—Journalistic Science.—A correspondent has forwarded a Newcastle paper (purporting to be *local*, but in reality *London*, as most of it is sent down ready manufactured), giving a description of the very disastrous fire which took place at the Friar's Goose Chemical Works, on the 2nd inst. From the following extracts which we cut from this report, it may be questioned whether the time has come for ordinary journalists to write about and advocate "Technical Education," when they, as educated men, are so deficient in chemical knowledge as to write a description like this:—"The principle on which the different parts of the works was arranged, was, to give the acid chambers an exalted position, so that the material might be easily conveyed, by means of immense pipes, to the places where it was needed for further manufacturing processes. The operations were thus commenced with the production of sulphuric acid, at the greatest possible distance from the river, and were finished nearer to the river's edge, with the manufacture of products—soda, alkali, &c.—ready for shipment. This acid, which is the principal agent in the manufacture of soda and alkali, is produced by the burning of pyrites or sulphate. In these works only pyrites was employed, and it is imported from Spain. After the burning process, it is put into a furnace along with salt, and exposed to the heat of a fire underneath. The result of this process is to produce sulphate of soda, which is, in its turn, converted into carbonate of soda, by being mixed with chalk and coals, and again exposed to a great heat. The furnaces which yielded this heat were principally under the acid chambers that have been destroyed. The product of the last-mentioned operation is turned into soda-ash or chrystals of soda by means of a process of carbonating or chrystalising. The flames leaped from one point to another until the whole of the roof covering this range succumbed to its devouring fury. Next to the acid chambers, the chief loss lay in the total destruction of four of Guy Luysack's towers to the west of the chambers. The erection of the towers themselves had been finished only lately. The lead had been got into them although the packing operations had not been quite completed. The object they were intended to serve was to recover the nitre and sulphurate acid processes."

CONTEMPORARY SCIENTIFIC PRESS.

Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Bulletin de la Société d'Encouragement.

April, 1868.

PAYEN, "Report on Hugon's Apparatus for the Preservation of Wood by Superficial Charring and for the Disaggregation of Rocks by the Action of Heat." "Some new Methods of Preparing Permanganate of Soda." MUTH, "On the Preparation of Pure Naphthaline from the Crude Products of the Distillation of Tar." C. PUSCHER, "A Cement for Attaching Brass to Glass." T. WIMMEL, "On the Adulteration of Japanese Wax." F. STOLBA, "On the Use of Paraffine in Crystallisation Experiments. An Improved Cement." G. C. WITTSTEIN, "On the Use of Sugar of Lead as a Glaze for Visiting Cards."

Dingler's *Polytechnisches Journal.*

May, 1868.

A. VON WALTENHOFEN, "On the Amalgamation of Zinc Plates for Voltaic Batteries." G. LUNGA, "On the Condensation of Hydrochloric Acid Gas in the Manufacture of Soda." MARTIN, "On the Transformation of the Colouring Matters of Madder into Alizarine. Experiments on the Use of Cockchafers as Manure."

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2116. J. B. Gregson, Gateshead, Durham, "An improved production of sulphate of lead to be used as a pigment or for other purposes."—Petition recorded July 2, 1868.

2136. A. McNeil, Tiverton, Devonshire, and W. Wheaton, Exeter, Devonshire, "An improved process for the manufacture of salts of ammonia from ammoniacal gas liquor."—July 4, 1868.

2157. A. P. Price, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of phosphates of lime, and in obtaining products therefrom."—A communication from E. Pelouze, and L. Dusart, Paris.—July 7, 1868.

2203. W. J. Hanson, Rawfolds, Cleckheaton, Yorkshire, "Improvements in dying wool or other fibrous substances."

2207. A. Munro, Arbroath, Forfarshire, N.B., and W. B. Adamson, Glasgow, N.B., "Improvements in the manufacture of iron and other metallic substances."—July 13, 1868.

2214. J. Baslow, Shepherd's Bush, Middlesex, "Improvements in bleaching or whitening textile fabrics, yarns, and threads made from flax, cotton, or other vegetable fibrous materials."—July 14, 1868.

INVENTIONS PROTECTED BY THE DEPOSIT OF COMPLETE SPECIFICATION.

2340. C. D. Abel, Southampton Buildings, Chancery Lane, "A new or improved process for separating the zinc from the argentiferous alloys obtained in the separation of silver from argentiferous lead by means of zinc, and improvements in the furnaces employed for that purpose."—A communication from H. Roux, Marseilles, France.—Recorded. July 25, 1868.

2368. W. R. Lake, Southampton Buildings, Chancery Lane, "Improvements in glue and in the mode of and apparatus for, manufacturing the same, the said improvements being also applicable to the manufacture of gelatine and other material."—A communication from C. Wahl, Chicago, Cook, Illinois, U.S.A.—July 18, 1868.

NOTICES TO PROCEED.

978. G. F. Guy, Bury St. Edmunds, Suffolk, "Improvements in the manufacture of sugar and other alimentary substances from beet-root."—Petition recorded March 22, 1868.

1045. A. Warner, Laurence Pountney Lane, London, "Improvements in the manufacture of cement."

1048. A. Scott, Blomfield Crescent, Paddington, Middlesex, "The production of an alcoholic fermented dry, sweet, or effervescent drink, of which tea or coffee or theine or caffeine is an essential ingredient."

1050. F. Bauman, Wellington Street, Strand, Middlesex, "The preparation of a certain combination of chemical substances, and its novel application to the treatment of wood or other fibrous material in the preparation of paper pulp."—March 27, 1868.

1187. V. Gallet. Lavausseau de Benassais, Vienne, France, "Improvements in the manufacture of steel."—April 8, 1868.

1800. C. H. Wells, New York, U.S.A., "A new and improved mode of impregnating wood with oleaginous and saline matters."—A communication from C. A. Seely, New York.—June 1, 1868.

NOTES AND QUERIES.

A Question in Pneumatics.—Air is 850 times lighter than water, and the pressure of the atmosphere is sufficient to sustain a column of water 33 feet high. Now, if it were possible to submerge a quantity of air in the sea to a depth of 28,050 feet and then set it free, would the air still possess buoyancy, and would it rise to the surface of the water?—Scientific American.

Estimation of Sulphur in Pyrites.—Hypochlorous acid may be used to transform the sulphur of pyrites into sulphuric acid, which is then estimated by baryta. Finely pulverise the mineral and suspend it in water, through which a current of gaseous hypochlorous acid, or better still hypochloric acid, is passed; this entirely dissolves the pyrites. Hypochlorous acid is prepared by heating a milk of carbonate of lime through which a current of chlorine is passed to saturation: $CaO,CO_2 + HO + 2Cl = CO_2 + ClOHO + CaCl$. Hypochloric acid is obtained by heating in a water-bath a tube, supplied with a cork and delivery tube, and containing a mixture of 9 eqs. of oxalic acid and 1 eq. of chlorate of potash.—F. Wöhler.

Analysis of Spathic Iron.—Dissolve in hydrochloric acid, to which is added a little nitric acid or chlorate of potash. Precipitate with ammonia, but be careful not to filter until the liquid has been boiled till all odour of ammonia has disappeared; the iron then contains no trace of lime, magnesia, or manganese. The liquid containing no trace of free ammonia, the filtration may be performed in contact with air. The filtrate must be concentrated by evaporation, and the three bases which it contains precipitated with an excess of carbonate of potash, continuing the ebullition so long as no ammonia is disengaged. Filter the liquid and re-dissolve the precipitate in nitric acid, then evaporate to dryness and carefully heat to dull redness. Dilute nitric acid will then separate the lime and magnesia from the insoluble oxide of manganese.—F. Wöhler.

Aurine.—Printing Ink.—I observe in No. 451 of the Chemical News—1st, that evidently from "R. G. B.'s" description he has not accurately read my short paper in No. 449 of the Chemical News; 2nd, that the details given by me in that paper did not and need not enter into *minutiæ* of manipulation required to bring out what I effectively did; 3rd, that "R. G. B." evidently overlooked what I stated about the unfitness of aurine pigments as oil colours and hence also their unfitness to colour printing ink. Aurine and roseine are not synonymous terms, and aurina is *not* practically soluble in *pure* water. Resin oil, *i.e.*, oil obtained from resinous substances, under peculiar manipulations, cannot advantageously replace the so-called *drying* oils in the manufacture of printing ink, since resin oil is not, by being exposed to a high temperature, converted into anhydride of linoleic acid, which is *de facto* the main constituent of good and genuine printing ink, and has been so for centuries.—Dr. A. A.

TO CORRESPONDENTS.

M. A. B.—Must excuse us for declining to enter into the controversy. Pie-juice is very good in its place, but it is not suitable for the pages of the Chemical News.

R. C. W.—We are much obliged for the extract and have made use of it.

Puzzled.—Messrs. Chalmers and Tatlock's paper on the estimation of potash, given in our pages in April last, will give you the information you want about purifying platinum.

O. P. Q.—Our publisher informs us that the numbers are out of print.

Chemical Novice.—A letter is waiting for you at our office.

Communications have been received from Hirst, Brooke and Hirst; J. R. Haas and Co.; F. W. Hartley; M. A. Baines (with enclosure); C. Heisch (with enclosure); E. Tanner; J. A. Branda; J. Syme (with enclosure); D. Dalrymple; Hinds Howell; J. Crompton; F. Ignacio Rickard; F. Foord; Dr. R. Augus Smith, F.R.S.; G. W. Eccles; D. Powell; H. McLeod; Ivan C. Michels (with enclosure); Townsend and Adams; F. A. Pooley; J. Ireland, Jun.; W. Little; Mitchell and Co.; A. L. Steavenson; J. Cliff; and H. Bassett (with enclosure).

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Appendix A containing additional information on Sulphur, Sulphuric Acid, Bisulphide of Carbon, Chloride of Sodium, Soda, Hydrochloric Acid, Potash, Soap, Glycerin, Aluminium and Sodium, Magnesium, Soluble Stannates, Arseniate of Soda, Silicates of Potash and Soda, Chlorate of Potash, Phosphorus, Lucifer Matches, Hyposulphite of Soda, Boracic Acid, Soluble Phosphates, Nitrate of Soda, Gunpowder, Gun-cotton, Nitroglycerine, and Prussiate of Potash.

Appendix B, containing Abstracts of Specifications of Patents relating to the materials and processes described in this and previous volumes.
Appendix C, Tables connected with these processes.
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THE CHEMICAL NEWS

Vol. XVIII. No. 454.

ON THE
PREPARATION OF IODIC ACID AND IODATE OF POTASSIUM.

By Professor J. S. STAS.

Iodic Acid.—I prepare this acid by the action of pure iodine on normal nitric acid. To effect this I operate on four litres at a time of pure nitric acid, to which I add a tenth of its weight of iodine. The yield of iodic acid given by this method has been much exaggerated; the quantity produced only represents one quarter of the weight of the iodine employed. In order to remove with certainty the nitric acid which the iodic acid always contains, I dissolve in water the solid yellowish residue, obtained on evaporating to dryness the liquid resulting from the reaction of iodine on fuming nitric acid. The solution of this crude acid, when introduced into a vessel made of glass unattacked by acids, is evaporated to dryness; the whole residue is heated to 200°, and kept at this temperature to bring it to the state of iodic anhydride, and to remove with the water the last trace of nitric acid which it contains.

As the action of nitric acid on iodine took place in a large retort of ordinary glass the iodic acid obtained contains traces of iodates of sodium and calcium, which I have not been able to remove.

I hoped to have been able to employ iodic acid in the determination of the atomic weight of iodine; with this object I prepared more than two kilogrammes of crystallised iodic acid by the action of boiling dilute sulphuric acid on iodate of barium; but, in spite of all precautions, I found it impossible to prepare in this manner either iodic acid or iodic anhydride free from barium, the greater part of which existed in the state of sulphate. After the efforts I made to remove the barium, I believe I may affirm that it is impossible to prepare pure iodic acid in this manner.

Iodate of Potassium.—Requiring large quantities of this salt, I tried many methods of preparing it. Only two furnished me with a product which was unalterable in the air. One consisted in transforming an aqueous solution of hydrate of potash into iodide and iodate, by acting on it with purified iodine; the other was based upon the formation of iodate by the action of heat on a mixture of equal molecular weights of iodide and chlorate of potassium. This is how I prepared the iodate by the latter method. I mixed intimately the iodide and chlorate of potassium previously purified from foreign metals by means of a solution of sulphide of potassium. The well-dried mixture was introduced into retorts till they were about two-thirds full, and they were then placed in sand-baths. In the same bath I inserted rather deeply a small retort containing pure chlorate of potash. Each retort had connected with it a curved tube dipping into water. I elevated the temperature of the bath until the chlorate of potash in the small retort fused, and oxygen commenced to be evolved. When I had succeeded in well graduating the temperature so as not to overstep the temperature of decomposition of iodate of potash by heat (a temperature which is sensibly higher for iodate than for chlorate), I had completely transformed the iodide into iodate, and the chlorate into chloride, without any disengagement of oxygen.

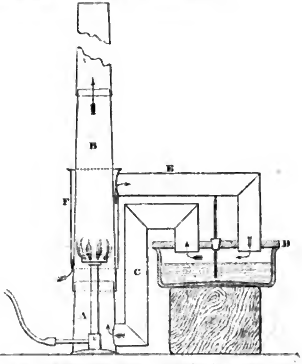
To separate the iodate from the chloride I added to the mass after cooling cold water in sufficient quantity to disintegrate the mixture. The saline mass was then ground up and, after being introduced into a displacement apparatus, was lixiviated with cold water until almost all the chloride was removed. The iodate was then submitted to *three successive crystallisations*. After each crystallisation, which was effected rapidly, the salt was submitted to a methodical washing. After the first crystallisation I was unable to discover a trace of chloride or iodide.

The iodate thus prepared remains indefinitely, without becoming yellow in the presence of air. This cannot be said of the salt which is obtained by attacking chlorate of potassium by means of iodine. Even when the terchloride of iodine which is always formed along with the iodate of potassium is decomposed by carbonate of potash, the salt so produced becomes very appreciably yellow in the air, even after it has undergone five successive crystallisations, each time followed by methodical washing. I have not been able to ascertain what is the substance which communicates to this iodate of potassium the property of becoming yellow, but the fact has always been so.

NOTE ON
A SIMPLE APPARATUS FOR EVAPORATION AT LOW TEMPERATURES.

By H. BASSETT.

Having had occasion to concentrate some solutions which would not bear the application of heat without partial decomposition, I was led to the construction of a little apparatus by means of which a comparatively large quantity of liquid may be evaporated in a short time at a temperature of 30°—40°, and of which I give a description, believing that such an arrangement is likely to be found useful in many cases. The accompanying sketch is drawn to scale, one-sixth of the actual size:—



A is an ordinary Bunsen's burner fixed at the bottom of a sheet-iron chimney, B, rather more than two feet high, and closed at the bottom. The air necessary for combustion is supplied by the zinc tube, C, which fits into a hole in the slate cover, D, ground flat and fitting the evaporating dish closely. Into the other hole in this cover is inserted the tube, E, of brazed copper, which is attached at the other end to the sheet-iron jacket, F, open at the bottom, but fitting tightly over the chimney at the top.

On lighting the gas, a strong current of air is established in the direction shown by the arrows, becomes heated by passing through the narrow space between the chimney and the jacket, F, and then sweeps over the surface of the liquid in the dish. Using the simple burner without the rose top, about a pint of water is evaporated (from a dish 6 inches in diameter) in 24 hours, the liquid never becoming heated above 30°. With the rose burner, which heats the chimney more strongly, about 1½ pint in the same time, the temperature rising to 40°—43°. The temperature of the current of air in the middle of the dish, above the liquid, is about 80° with the simple burner, and 120° with the rose.

NOTE ON

METALLIC BISMUTH, AND LIQUOR BISMUTHI ET AMMONIÆ CITRATIS.

By DR. REDWOOD.

The vicissitudes which have attended the commerce of bismuth for several years past have produced an unfavourable influence on the condition, in regard to purity, of some of the preparations of bismuth which are used in medicine. The price of the metal has undergone great fluctuations, ranging from 2s. 6d. to more than 20s. a pound; and, although the highest prices to which it has thus attained have been unprecedented in its previous history, the proportion of impure bismuth in the market has, at the same time, been unusually large. This unsatisfactory state of things appears to have arisen from a falling off in the supply of bismuth from those localities whence the best samples have been obtained, while new sources of supply, especially the Australian, have yielded the metal in a state in which its purification has been attended with considerable difficulty. Of the impurities most commonly occurring, arsenic, lead, copper, and silver are the most important. The bismuth may be freed from the first two of these, if present, with comparative ease, by a simple metallurgical operation, which consists in fusing it with nitre, as directed in the Pharmacopœia. This is the process usually adopted, and which answers best for removing the more oxidisable metals. It may be conveniently and successfully applied to quantities of the metal varying from four ounces to a pound by means of a gas furnace. The process, however, is insufficient for the removal of copper and silver; and it is with reference especially to the former of these that the principal difficulty is experienced in purifying some of the crude bismuth and bismuth ores of commerce. At the present time large quantities of Australian ore, rich in copper, are waiting the discovery of a method by which the bismuth it contains may be economically separated in a state of sufficient purity to admit of its being used for pharmaceutical purposes. When this question has been satisfactorily solved, there is every reason to believe that a great reduction in the price of the metal will take place. In the meantime we shall have much impure bismuth containing copper, which, although applicable for one of the purposes for which bismuth is required,—namely, the preparation of fusible metal,—is not well suited for the production of the compounds of bismuth used in medicine. Already the attention of metallurgists has been directed to the importance of providing a supply of purified bismuth for pharmaceutists, and I am assured by houses extensively engaged in this branch of metallurgy that bismuth, free from arsenic, copper, or any material impurity, may now be obtained by those who are willing to pay the price for it.* As this purified bismuth is prepared by men accustomed to such operations from the ores which yield it most readily, it will be found the most economical and best course for those who require pure bismuth to buy the metal in the purified state, or otherwise it will be necessary, in applying the process of the Pharmacopœia, to use crude bismuth which is free from copper and silver.

With reference to *Liquor Bismuthi et Ammoniæ Citratis*, on which there has been some correspondence in the *Pharmaceutical Journal*, it may be stated that, if the conditions specified in the Pharmacopœia be fulfilled, that is to say, if the bismuth employed has been purified in the manner described, and if the purified metal, and also the solution prepared from it, answer to the tests as given, the latter will be free from arsenic, lead, copper, and silver. These are the impurities most likely to occur, and to the removal or detection of which the process of purification and the tests of the Pharmacopœia are directed; but if it were the object of a manufacturer to introduce other impurities which would elude detection by the tests as given, it would no doubt be possible to do so. I have recently met with two instances of such adulteration in subnitrate of bismuth, an account of which will be found in the following article.—*Pharmaceutical Journal.*

NOTE ON

A NEW ADULTERATION OF SUBNITRATE OF BISMUTH.

By DR. REDWOOD.

I have recently had occasion to examine two samples of subnitrate of bismuth, which have proved to be adulterated to a great extent, by the admixture of a substance which none of the tests usually applied would detect. These samples were sent for examination by wholesale druggists who had been led to suspect that they were not genuine, but who were greatly surprised to learn the extent and nature of the adulteration.

The first of the samples was sent me last May. It presented the usual appearance of the variety of subnitrate of bismuth generally met with in commerce in the form of powder, without any crystalline character. It dissolved in nitric acid with a slight evolution of carbonic acid gas, and this had caused it to be condemned as impure by a customer to whom it had been sent. The quantity of carbonate present in it was, however, extremely small. In other respects it answered to the Pharmacopœia tests, excepting that the solution in nitric acid gave a precipitate with nitrate of silver indicating the presence of oxychloride. This is so frequently met with in commercial subnitrate of bismuth that its detection would not have excited much surprise. Its presence is excused by manufacturers on the ground of its making the powder more suitable for some of the purposes to which it is applied, so that for such purposes the powder would be unsaleable if it did not contain any chloride. The chlorine having been estimated, and the equivalent quantity of oxychloride calculated therefrom, a further examination rendered it evident that there was something else present besides subnitrate of bismuth. The residue left after calcination was in excess of that which theory indicated; and this residue dissolved in nitric acid, mixed with dilute acetic acid, and precipitated with sulphuretted hydrogen, gave an amount of sulphide much below the theoretical quantity. The cause of these discrepancies was found in the filtrate, which yielded an abundant precipitate of phosphate of lime.

While I was engaged in this investigation, my attention was directed to a paper in the *Journal de Pharmacie et de Chemie* for last March, by Mr. Roussin, in which he alludes to the adulteration of subnitrate of bismuth with phosphate of lime, and describes a very simple method of detecting it. Mr. Roussin says that in one case he found as much as 28 per cent of phosphate of lime in a sample which presented the usual appearance and answered to the ordinary tests of subnitrate of bismuth. His process for its detection and estimation is as follows:—Dissolve equal quantities of the subnitrate and of tartaric acid in nitric acid slightly diluted with water, and add to this a strong solution of carbonate of potash until all effervescence has ceased, and the liquid is rendered strongly alkaline. "If the subnitrate of bismuth be pure the liquid will be clear, and will remain so even after it has been boiled, but if the sample of subnitrate submitted to the test should contain phosphate of lime, even to the extent of 1 or 2 per cent, this will form a white precipitate, which will not dissolve with long-continued boiling."

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* I have recently purchased such at 20s. a pound, the price of crude bismuth being at the same time 18s. a pound.

In applying this test, it is important to observe that the phosphate of lime, even when present in large quantity, is not precipitated in the first instance after the addition of the carbonate of potash, but its precipitation is immediately effected by boiling the solution. From the sample to which I have already referred I obtained in this way 11 per cent of phosphate of lime, and from another sample, which came from a different source, I have more recently obtained no less than 40 per cent of the same adulterant.

I have reason to believe that both these samples were of foreign manufacture.—*Pharmaceutical Journal.*

ON
IODIDE OF SILICIUM AND SILICI-IODOFORM.

By M. C. FRIEDEL.

In their very interesting article on the action of chlorhydric, bromhydric, and iodhydric acids upon silicium,* Messrs. Wöhler and Buff have described a crystalline substance of amaranthine colour, fusible, and soluble in sulphide of carbon, and considered by them to be iodhydrate of iodide of silicium. The study made by M. Ladenburg and myself of the action of chlorhydric acid on silicium showed that it was composed of two distinct bodies—chloride of silicium, $SiCl_4$, and silicichloroform, $SiHCl_3$—which would lead to the supposition that the iodised substance obtained by MM. Wöhler and Buff, consisted of a similar combination. This supposition I propose to verify.

The first experiment, in which the directions given in the above article were exactly followed, yielded a violet product manifestly containing free iodide. It was dissolved in sulphide of carbon and shaken up with metallic mercury; the solution was discoloured, and there remained, after the removal of the sulphide of carbon by distillation, a yellowish liquid, which on cooling became a crystalline mass, nearly white, and distilling at 285°. During distillation this product is coloured anew by the liberation of a certain quantity of iodine. The roseate crystalline substance thus obtained fumes in the air, decomposes in water, and dissolves in potash with evolution of hydrogen. This latter quality has been used to determine its nature. A bubble of thin glass, containing a given weight of the substance, was broken in a receiver inverted over mercury, and containing some cubic centimetres of potash. The quantity of hydrogen thus liberated is too small to agree with MM. Wöhler and Buff's, or any other accepted formula. Considering the product as a mixture of iodide of silicium, SiI_4, and of the compound $SiHI_3$, analogous to silicichloroform, the proportion of the latter is perceived to be less than 8 per 100. The estimation of silicium confirms this conclusion, by giving figures similar to those which correspond with iodide of silicium.

The proportion of the hydrogenised compound being so small, one could scarcely hope to separate it in such a way as to obtain it pure, retaining at the same time the purity of the iodide of silicium. In order to ascertain its qualities and composition the preferable mode is to prepare the iodide of silicium direct and in the absence of hydrogen. I have succeeded in causing the vapour of iodine to pass along with a current of completely desiccated carbonic acid, over crystallised silicium heated to redness. If the distillation of iodine is rapid, or if the silicium does not fill the tube, the product obtained is mixed with much iodine. This has led to the belief that iodide of silicium will not form under these conditions. If, on the other hand, caution be used, and a tube be procured of sufficient length filled with silicium, the crystals sublimed in the cool part of the tube will be white, and the liquid proceeding from their fusion yellowish. The product thus obtained, purified when necessary from iodine by solution in sulphide of carbon and agitation with mercury, may be distilled in a current of carbonic acid without decomposition. Not so in the air, where its vapour on being heated catches fire, and burns with a red flame emitting much iodine vapour. The product distilled in carbonic acid is colourless or slightly yellowish. Its boiling point is 290°, and at 120·5° it solidifies and crystallises into a mass having a watered appearance (moiré) which is nearly always rose coloured, owing to a slight decomposition which takes place at the moment the tube is sealed. In those parts of the vessel which were merely moistened by the liquid, dendrites are formed analogous to those of chlorhydrate of ammonium. The crystalline form of iodide of silicium is cubic, and it may be obtained either by sublimation, evaporation, or refrigeration of its solution, in small regular octahedrons or groups of octahedrons, which are transparent, colourless, and incapable of action on polarised light.

Iodide of silicium decomposes in water with formation of silica and iodhydric acid, without liberation of hydrogen or precipitation of iodine. This reaction suffices to prove that its composition is analogous to that of the chloride, $SiCl_4$. Its analysis is performed by breaking in a stoppered flask, and containing dilute ammonia, a glass bubble filled with the substance. When decomposition ceases, the liquid is evaporated in the same flask over a water-bath, a current of air being passed into it by means of an aspirator, and the liquid produced by evaporation condensed in a cool receiver. Without the latter precaution part of the iodine would be lost. After evaporation to dryness, the residue is taken up by the condensed water, filtered, and washed; and in order to obtain the weight of the silica, it is merely necessary to deduct from the weight found, that of the bubble. The iodine is precipitated in the filtered liquid. Thus figures are found agreeing with the formula SiI_4. Following the excellent process of MM. Sainte-Claire Deville and Troost, the density of its vapour was taken in mercurial vapour. It was found indispensable to fill the globe with carbonic acid, and sundry precautions were used to prevent the re-entrance of air. At the close of the experiment, the globe proved to contain no free iodine. The number obtained for the density was 19·12. The theoretical value corresponding with the formula SiI_4, and with two volumes of vapour is 18·56. These results complete the analogy of iodide of silicium with the chloride.

Not so in all its reactions. If absolute alcohol be allowed to fall upon iodide of silicium drop by drop, a quick liberation of iodhydric acid ensues, but there is no formation of silicic ether. Iodide of ethyl mixed with alcohol is produced on distillation if four molecules of alcohol be employed to one of iodide, and a spongy mass of silica remains in the receiver.

The reaction is explained by the equation—

$$SiI_4 + 2C_2H_6O = SiO_2 + 2C_2H_5I + 2IH.$$

Silici-iodoform.—Iodide of silicium being thus obtained pure, the hydrogenised body now remained to be isolated. I believed it might be possible, by causing iodhydric acid to act upon silicium in the presence of hydrogen, to augment the quantity produced from the reaction of MM. Wöhler and Buff. This belief has in fact been realised, and although the proportion obtained is still small, a sufficient quantity of the new compound may be procured to enable us to determine its principal properties. Little drops of it are condensed in the cool end of the tube at the same time as the iodide of silicium; these may be partially isolated by decantation. A small quantity of the liquid product was also obtained by distilling the crystallised mass imbued with the liquid, and after tedious operations twenty grammes were collected of a colourless liquid highly refractive, and very dense, boiling at about 220°, and shown by analysis to possess the composition $SiHI_3$.

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* *Annalen der Chemie und Pharmacie*, civ. 99.

This body may therefore be called *silici-iodoform* from its analogy with silicichloroform. When decomposed by water it yields, like the chlorine compound, a white substance which liberates hydrogen. This is doubtless no other than the siliciformic anhydride, whose composition was made known by M. Ladenburg and myself.

The density of silici-iodoform is 3·362 at 0, and 3·314 at 20°, without correction for the dilatation of glass. Its density is almost as great as that of thallic alcohol. It may perhaps be slightly diminished, as the product upon which I experimented still contains traces of iodide of silicium. As the extreme stability of the chloride of silicium and silicichloroform is not shared by the iodide of silicium and silici-iodoform, it is to be hoped that, by means of these latter, new compounds may be formed which were unobtainable by employment of the chloride. —(*Comptes Rendus*, lxvii., 98.)

ON THE
PRODUCTION OF CHLORINE AND OXYGEN.

By M. A. MALLET.

I had occasion last year to call the attention of the Academy to my process of preparing oxygen. I then pointed out, amongst its other advantages, the possibility of also obtaining chlorine by the simple addition of chlorhydric acid. As certain novel, or but slightly known, reactions have brought this process into some note, a few explanations are necessary. The fixation of atmospheric oxygen upon protochloride of copper allows two results to ensue; either the disengagement of oxygen, supposing the desired end be to collect that gas, or the decomposition of chlorhydric acid and liberation of chlorine, should the production of that body be desired.

The absorption of oxygen by protochloride of copper is spontaneous, and takes place at the ordinary temperature in a few hours, provided the air be sufficiently moist, and especially if the surfaces be renewed. If the temperature be raised the absorption is more rapid, and this is the most important part of the question, for by raising the temperature to between 100° and 200° or even higher, in the presence of steam, absorption may be considered as almost instantaneous.

A demonstration of this may be made by means of a balloon containing some grammes of protochloride of copper, and communicating with a graduated receiver. The balloon is then heated, and by means of a suitable arrangement several drops of water are injected upon the substance without allowing any communication with the exterior air; absorption takes place immediately, and the water rises in the receiver. By restoring the apparatus to its original temperature and pressure, the oxygen will prove to be completely absorbed provided the substance should have been suitably proportioned. Thus the protochloride of copper may be reoxidised in a few minutes at a temperature differing but slightly from that required for deoxidation, a fact which is of great industrial importance with regard to continuity of operation.

If upon protochloride of copper, heated to 100° or 200°, commercial chlorhydric acid be slowly dropped, steam alone will be disengaged, and supposing the addition of acid to be slow enough, and the access of air and renewal of surface sufficient, the odour of chlorhydric acid will be scarcely perceptible, and the whole protochloride will transform into anhydrous bichloride, CuCl, which, when heated in a close vessel, instantly disengages chlorine. The simultaneous absorption of oxygen and chlorhydric acid is an important fact and interesting to know, because the extraction of the chlorine from the acid takes place in this case by means of the atmospheric air, and in an absolutely direct manner. With gaseous chlorhydric acid the action is the same, in fact better, provided the acid gas contain, as is always the case, a certain quantity of steam, and that the accession of air be sufficient.

The presence of water is necessary to the absorption of oxygen by protochloride of copper.

Oxidation and chlorination take place very quickly at high temperatures, but the great advantage is that they yield dry products, which is very convenient, inasmuch as steam is frequently a source of inconvenience and alteration of apparatus.

The retorts which I employ are rotatory, and serve either for decomposition or vivification; they are made of cast iron, and a simple refractory coating in the interior effectually preserves the metal from destruction. The reactions described have been demonstrated upon quantities of matter large enough to produce, after each operation, several cubic metres of oxygen or chlorine. From a manufacturing point of view, it may be considered that 100 kilogrammes of protochloride of copper, mingled with sufficient inert matter to facilitate manipulation, will produce practically from three to three and a half cubic metres of oxygen, or from six to seven cubic metres of chlorine. As four or five operations at least may be performed in twenty-four hours, it is plain that 100 kilogrammes of substance will produce from fifteen to eighteen cubic metres of oxygen, or from 200 to 300 kilogrammes of chloride of lime, in twenty-four hours.

The price of the raw material does not exceed one franc the kilogramme, and the loss is ascertained by experience to be always very small; this is easily understood as the substance does not leave the retort, but undergoes all the processes within it.—(*Comptes Rendus*, lxvi., 349.)

ON THE BLEACHING OF PALM OIL.

By M. ENGELHARDT.

M. Engelhardt, of Leipzic, effects in the following manner the blanching of palm oil by means of bichromate of potash and chlorhydric acid:—

A given quantity of palm oil is placed in an iron pot, heated to about 62° C., and allowed to stand all night. The next day it is poured into a clean vessel and cooled to 40° or 37° C. Meanwhile a certain quantity of water, say for instance 45 kilogrammes of water to 1,000 of palm oil, is set to boil; in it are dissolved 15 kilogrammes of bichromate of potash, and when the solution has cooled a little, 60 kilogrammes of chlorhydric acid are added. This mixture is then poured into the palm oil, which must be quickly stirred, and in about five minutes it will assume a sombre green colour from the reducing action of the combination of the chromate with the chlorhydric acid. By continuing to stir, the separation of the oxide of chromium is completed, and the oil gradually clarifies and becomes at last quite limpid. In order to render it quite white it is now only necessary to wash it in warm water; if, however, it should not appear quite colourless, the operation must be repeated with 0·25 kilogrammes of red chromate and 1 kilogramme of chlorhydric acid. This method is quick, free from danger, and produces very good results. The author declares that the new methods in which either gaseous chlorine, chloride of lime, or a mixture of chlorhydric acid with peroxide of manganese are proposed, are much inferior to the above process.—(*Dingler's Polytechnisches Journal*).

TRANSFORMATION OF THE AROMATIC MONAMINES INTO ACIDS RICHER IN CARBON.[*]

III. MENAPHTYLAMINE.

By A. W. HOFMANN, LL.D., F.R.S.

THE transformation of naphtaline into its carboxylic acid suggests the existence of a large number of compounds which the progress of science cannot fail to realise. It is not my intention to examine in detail this group of substances, the composition and even the properties of which are sufficiently indicated by theory. There are, nevertheless, several terms of this series which I must not leave unprepared whilst engaged with this question. These are the aldehyde, the alcohol, and the monamine of the series.

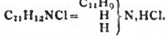
My first attempts to produce the aromatic monamine were anything but successful. Cyanide of naphtyl, when left in contact with zinc and sulphuric acid, even for weeks, was found to yield but trifling quantities of menaphtylamine. The greater portion of the nitrile was left unchanged, while more or less, by the absorption of the elements of water, was converted into menaphtoxylamide, and even into menaphtoxylic acid. A slight modification, however, of the process usually adopted has removed these difficulties.

It is well known that M. Mendius, after he had discovered the remarkable property possessed by nitriles of fixing two molecules of hydrogen, has submitted also the amides to the action of hydrogen *in conditione nascendi*, in the hopes of replacing their oxygen by hydrogen, and of producing also in this manner the primary monomines. These experiments have not been successful. In the presence of the difficulties attending the preparation of menaphtylamine, the idea suggested itself of trying whether the sulphuretted amide of the series into which the nitrile is so easily transformed would not be more readily attacked by nascent hydrogen than the nitrile itself. The result of this experiment was highly satisfactory. On submitting an alcoholic solution of menaphtothiamide to the action of zinc and hydrochloric acid, torrents of sulphuretted hydrogen are at once evolved. The addition of zinc and hydrochloric acid, and sometimes also of a little alcohol, is continued, until, after a day or two, the disengagement of sulphuretted hydrogen almost ceases. The liquid is now mixed with concentrated soda until the precipitate of hydrate of zinc, which is formed in the commencement, is redissolved. An oily layer, containing much soda and alcohol, is seen to separate and to collect on the surface of the aqueous solution. This layer is removed and heated in the water-bath until the alcohol is volatilised. An aqueous liquid is thus produced, on which a yellow oil is floating. The latter is principally menaphtylamine, which is still mixed with a small quantity of cyanide of naphtyl regenerated from the thio-compound. The oil is treated with dilute hydrochloric acid, the hydrochloric liquid separated by filtration from the cyanide, and decomposed by hydrate of sodium, when the base separates in a state of purity.

Menaphtylamine is a very caustic liquid, boiling between 290° and 293°. Freshly distilled it is colourless, but soon acquires a yellow tint. It attracts carbonic acid with such avidity that it is impossible to pour it from one vessel into another without a pellicle of the difficultly soluble carbonate being formed on its surface.

The composition of the base was sufficiently indicated by theory; it appeared, nevertheless, desirable to establish it experimentally by the analyses of the hydrochlorate and the platinum salt.

The hydrochlorate crystallises with the greatest facility in difficultly soluble needles, containing—



$$C_{11}H_{12}NCl = \left.\begin{matrix} C_{11}H_9 \\ H \\ H \end{matrix}\right\} N,HCl.$$

The yellow crystalline precipitate which is formed by the addition of perchloride of platinum to the hydrochlorate has the composition

$$C_{22}H_{24}N_2PtCl_6 = 2\,[(C_{11}H_9)H_2N,HCl]\,,PtCl_4.$$

The transformation of the thio-compound into menaphtylamine is thus seen simply to consist in the substitution of two atoms of hydrogen for one atom of sulphur:—

$$C_{11}H_9NS + 2HH = C_{11}H_{11}N + H_2S.$$

I have but little to say about the properties of menaphtylamine; nevertheless, the extraordinary crystalline tendencies of its salts deserve to be mentioned. The sulphate and nitrate are likewise difficultly soluble; the latter crystallises in splendid nitre-like prisms. In contact with bisulphide of carbon, menaphtylamine solidifies at once to a crystalline mass. When treated with alcoholic soda and chloroform, it is converted into the terribly-smelling formomenaphtylnitrile, which I propose to examine somewhat more in detail.

I have also prepared benzylamine, starting from thiobenzamide instead of benzonitrile. The experiment is, of course, likewise successful—the advantage, however, less conspicuous—since benzonitrile fixes hydrogen with far greater facility than the cyanide of naphtyl.

Be this, however, as it may, the facility with which hydrogen *in conditione nascendi* acts upon sulphur-compounds deserves to be noticed. I propose to examine, in the direction indicated by the above experiments, some of the more important sulphur-compounds, more especially the thio-acids of the fatty and aromatic series, and the two groups of sulpho-cyanic ethers. The investigation of the latter, indeed, has already furnished me results of great neatness and precision.

In conclusion, I must not leave unmentioned that, since my first communication on the menaphtan series, I have had an opportunity of removing the slight doubts respecting the identity of the acid obtained by the action of oxalic acid upon naphtylamine with that procured by treating a naphtalin-sulphate with cyanide of potassium. M. V. Merz had found the fusing-point of the latter acid to be 140°, whilst for the former I had observed the fusing-point 160°. M. O. Olshausen has since prepared, in my laboratory, a quantity of cyanide of naphtyl, according to Merz's process. The acid obtained from this cyanide, by treatment with an alkali thrice recrystallised and finally purified by distillation, was likewise found to fuse exactly at 160°. Menaphtoxylamide, procured from the same source, exhibited the fusing-point 203°, while the compound I had formerly examined fused at 204°[*]. The identity of the acids obtained by the two processes is thus satisfactorily established.

ON THE PREPARATION OF URIC ACID FROM PERUVIAN GUANO.

By DR. JULIUS LÖWE.

To prepare uric acid from Peruvian guano in large quantities the following method is preferable:—Take equal weights of common sulphuric acid and Peruvian guano; heat the sulphuric acid in a porcelain capsule by means of a water-bath, and add to it little by little the guano, previously pounded and dried at 100° C., stirring well with a glass rod. When large quantities are used, the necessity of introducing the guano very gradually is all the greater, as the surface of the mixture is covered with froth, and a liberation of much carbonic and chlorhydric gas occurs, which will cause the mixture to run over unless the top of the capsule present a wide empty space. The strong exhalations of chlorhydric gas consequent upon this process are so unpleasant that, where operations are on a large scale, it is advisable to arrange the laboratory so as to facilitate their escape to the exterior. As long as these exhalations continue, the pasty compound thus obtained should remain in the water-bath; but when the odour has become faint and the mass appears thoroughly homogeneous, it must be diluted with ten or twelve times its quantity of distilled water. The yellow precipitate which then falls is allowed to settle in a large vessel, the supernatant liquid is decanted, and the precipitate well washed by agitation with plenty of pure water. It is then placed upon a good and easily permeable filtering paper, upon which it is again washed with cold water until the greater part of the sulphuric acid has been removed. This precipitate is now boiled in a weak alkaline solution in small portions at a time, producing a liquid which is filtered, and receives an addition of dilute chlorhydric acid which precipitates the uric acid in the form of a yellow cloud, which quickly thickens and falls in a crystalline powder. When this point has been reached, and the liquid has cooled, the acid is collected on a filter, washed, and dried. If it be desirable to remove the yellow colour which remains it will only be necessary to heat it again in a water-bath with its own weight of common sulphuric acid, and repeat the process above described. Frequently after the second solution of the uric acid, the warm mixture will take the form of a crystalline mass composed of sulphuric and uric acids. When examined with the microscope the crude acid appears to be an homogeneous mass, burns without residuum and contains only traces of guanine, which may be perceived by boiling the mass in chlorhydric acid. In thus purifying the crude uric acid by a second solution in sulphuric acid, care must be taken to add only the quantity of water necessary to deposit the uric acid, and that very gradually, as an excess of water always communicated a yellow colour to this acid, and the matter which causes it appears to be more soluble in concentrated than in dilute sulphuric acid.

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[*] Read before the Royal Society, June 18th, 1868.

[*] The fusing-point of this substance is, by misprint (Proc. Roy. Soc., vol. xvi., p. 302), stated to be 244°, instead of 204°.—A. W. H.

The modes of purification proposed by MM. Wöhler and Heintz have had equal success with the crude acid obtained by the process above described; M. Heintz's especially was successful in the first operation.—(*Journal für Praktische Chemie*).

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

Varieties of Food—their Chemical and Composition Nutritive Value.

THE economy of food, in its fullest signification, is a matter of national importance; for the political influence of a nation is as much dependent upon the muscular strength of the people as upon their intelligence and commercial industry; and this strength is wholly referable to a right use and proper distribution of food.

We perceive this not merely in the calamities of actual want, as in the fevers of famine, but also in the less prominent, but equally significant, decline of health in times of partial distress, when the vigour and energy of the poorer part of the population are so reduced as to lay them open to disease. In fact, the experience of our public hospitals too often elicits the fact that the wasted power of the patient has been the advent of incurable disease. Nor is this all; for as Mr. Simon observes—"Long before insufficiency of diet is a matter of hygienic concern; long before the physiologist would think of counting the grains of nitrogen and carbon which intervene between life and starvation, the household will have been utterly destitute of material comfort; clothing and fuel will have been scantier than food; against inclemencies of weather there will have been no adequate protection; dwelling-space will have been stinted to the degree in which overcrowding produces or increases disease; the home will be where shelter can be cheapest bought, where sanitary appliances are least considered, and where cleanliness is almost impossible." And all this distress falls heaviest upon those who are least able to bear it—the mother and her children; for the father, to be able to work, even lightly, must eat, and thus the others are the largest sufferers. Bad, however, as the immediate consequences are, they are nothing in comparison to the remote—the sickly race that comes of want.

In examining, therefore, this question of the economy of food, we must not only look at the nutritive value of different articles of diet, but we must also consider how food can be best distributed and utilised.

To-day we will investigate the principal varieties of food, and ascertain their peculiar qualities and dietetical values. For this purpose it will be necessary to have some standard for comparison, but this is avowedly a difficult matter; for if we compare foods according to the proportions of their principal constituents—viz., albuminous matters, starchy, saccharine, and saline—we shall find that the relative quantities vary to such a degree as to make the comparison almost useless; and if we fix our attention on one of these constituents—the nitrogenous, for example—and make it the exponent of nutritive value, we get into the difficulty of either overloading the equivalent with a large amount of carbonaceous material, or of having it deficient therein. If, for instance, we desire to know the quantities of different foods which would furnish the 1,200 grains of nitrogenous matter required by a man in his daily diet, we should find that the following are the proportions:—

TABLE I.

Proportions of Different Foods Required to Yield 1,200 Grains of Nitrogenous Matter.

	Grains.		Pounds.
Skim cheese	2,681	—	0·4
Lean meat	6,217	—	0·9
White fish	6,630	—	1·0
Fat meat	9,231	—	1·3
Fat bacon	13,636	—	2·0
Bread	14,815	—	2·1
Rice	19,048	—	2·7
New milk	29,268	—	4·2
Potatoes	57,143	—	8·2
Parsnips or turnips ..	100,000	—	14·3
Beer or porter	1,200,000	—	171·4

In this manner tables have been constructed of the nutritive values of food, and I show you one of them.

TABLE II.

Nutritive equivalents—calculated according to the amounts of Nitrogen in the Dry Substances; Human Milk being 100:—

VEGETABLE.			
Rice	81	Oats	138
Potatoes ..	84	White bread	142
Maize	100	Black bread	166
Rye	106	Peas	239
Radish ..	106	Lentils ..	276
Wheat.. ..	119	Haricots ..	283
Barley	125	Beans.. ..	320
ANIMAL.			
Human milk	100	Lamb	883
Cow's milk..	237	White of egg	845
Yolk of egg..	305	Lobster ..	859
Oysters ..	305	Skate	859
Cheese ..	331	Veal	873
Eel	434	Beef	880
Mussel ..	528	Pork	893
Ox-liver ..	570	Turbot ..	898
Pigeon ..	756	Ham	910
Mutton ..	773	Herring ..	914
Salmon ..	776		

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* The Cantor Lectures, delivered before the Society of Arts.

I hardly need say that comparisons of this description are of little practical value, for they furnish no indication of the digestive labour required to utilise the products; besides which we are far from being assured, at the present time, that the nitrogenous elements of our foods are the most important.

In framing, therefore, a table of alimentary equivalents, regard must be paid to all the constituents. This I have endeavoured to express in Table No. 3, wherein I have shown the per cent of nitrogenous and carbonaceous matter, and the proportions of the latter to one of the former; but here again the actual value of the several carbonaceous compounds is very different; for, although the fattening and respiratory powers of starch, gum, sugar, and pectin, may be nearly the same, yet the power of fat is about 2·5 times as great as that of sugar; and this must be considered, irrespective of other functions of fat, in estimating the value of carbonaceous food.

TABLE III.—NUTRITIVE VALUES OF FOOD.

	Water.	Albumen, &c.	Starch, &c.	Sugar.	Fat.	Salts.	Total Per Cent.		Carbonaceous to one Nitrogenous.
							Nitrogenous.	Carbonaceous.	
Bread	37	8·1	47.4	3·6	1·6	2·3	8·1	52·6	6·5
Wheat flour	15	10·8	66·3	4·2	2·0	1·7	10·8	72·5	6·7
Barley meal	15	6·3	69·4	4·9	2·4	2·0	6·3	76·7	12·2
Oatmeal	15	12·6	58·4	5·4	5·6	3·0	12·6	69·4	5·5
Rye meal..	15	8·0	69·5	3·7	2·0	1·8	8·0	75·2	9·4
Indian meal	14	11·1	64·7	0·4	8·1	1·7	11·1	73·2	6·6
Rice	13	6·3	79·1	0·4	0·7	0·5	6·3	80·2	12·7
Peas	15	23·0	55·4	2·0	2·1	2·5	23·0	59·0	2·5
Arrow root	18	—	82·0	—	—	—	—	82·0	—
Potatoes	75	2·1	18·8	3·2	0·2	0·7	2·1	22·2	10·6
Carrots	83	1·3	8·4	6·1	0·2	1·0	1·3	14·7	11·3
Parsnips	82	1·1	9·6	5·8	0·5	1·0	1·1	15·9	14·5
Turnips	91	1·2	5·1	2·1	—	0·6	1·2	7·2	6.0
Sugar	5	—	—	95·0	—	—	—	95·0	—
Treacle	23	—	—	77·0	—	—	—	77·0	—
New milk	86	4·1	—	5·2	3·9	0·8	4·1	9·1	2·2
Cream	66	2·7	—	2·8	26·7	1·8	2·7	29·5	10·9
Skim milk	88	4·0	—	5·4	1·8	0·8	4·0	7·2	1·8
Buttermilk	88	4·1	—	6·4	0·7	0·8	4·1	7·1	1·7
Cheddar cheese	36	28·4	—	—	31·1	4·5	28·4	31·1	1·1
Skim do.	44	44·8	—	—	6·3	4·9	44·8	6·3	0·1
Lean beef	72	19·3	—	—	3·6	5·1	19·3	3·6	0·2
Fat do.	51	14·8	—	—	29·8	4·4	14·8	29·8	2·0
Lean mutton..	72	18·3	—	—	4·9	4·8	18·3	4·9	0·3
Fat do.	53	12·4	—	—	31·1	3·5	12·4	31·1	2·5
Veal	63	16·5	—	—	15·8	4·7	16·5	15·8	1·0
Fat pork	39	9·8	—	—	48·9	2·3	9·8	48·9	5·0
Green bacon..	24	7·1	—	—	66·8	2·2	7·1	66·8	9·4
Dried do...	15	8·8	—	—	73·3	2·9	8·8	73·3	8·3
Ox liver	74	18·9	—	—	4·1	3·0	18·9	4·1	0·2
Tripe	68	13·2	—	—	16·4	2·4	13·2	16·4	1·3
Poultry	74	21·0	—	—	3·8	1·2	21·0	3·8	0·2
White fish	78	18·1	—	—	2·9	1·0	18·1	2·9	0·2
Eels	75	9·9	—	—	13·8	1·3	9·9	13·8	1·4
Salmon	77	16·1	—	—	5·5	1·4	16·1	5·5	0·3
Entire egg	74	14·0	—	—	10·5	1·5	14·0	10·5	0·7
White of do.	78	20·4	—	—	—	1·6	20·4	—	—
Yolk of do.	52	16·0	—	—	30·7	1·3	16·0	30·7	1·9
Butter and fats	15	—	—	—	83·0	2·0	—	83·0	—
Beer and porter	91	0·1	—	8.7	—	0·2	0·1	8·7	87·0

Another method of determining the values of food is by estimating the proportions of nitrogen and carbon in them, and comparing them with the proportions required in a standard diet.

Judging from the minimum quantities of food which an ordinary individual is capable of existing on without suffering in health, it would seem that about 4,100 grains of carbon, and 190 grains of nitrogen, are required in his daily diet. These proportions have been determined from a large number of observations, as by those of Dr. Lyon Playfair, in his inquiries into the dietaries of hospitals, prisons, and workhouses, and by those of Dr. Edward Smith, in his examination of the amounts of food which the Lancashire operatives were capable of living on during the cotton famine, and also by his inquiries into the dietaries of in-door labourers. The proportions which Dr. Smith gives as a famine or barely sustaining diet, are the following:—

	Carbon (grains).		Nitrogen (grains).
Adult woman	3,900	..	180
Adult man	4,300	..	200
Average adult	4,100	..	190

These proportions are contained in 2 lbs., and in 2 lbs. 3 oz. of bread; and they closely accord with another set of facts derived from an examination of the amounts of carbon and nitrogen exhaled and secreted from the body during health and idleness.

Taking these numbers, therefore, as the exponents of the nutritive values of food, we are able to construct the following table:—

TABLE IV.—NUTRITIVE VALUES OF FOOD.

	Grains per Pound.		Value per Pound.	Grains for One Penny.		Weekly Cost of Famine Diet for	
	Carbon.	Nitrogen.	d.	Carbon.	Nitrogen.	Carbon. d.	Nitrogen. d.
Split peas	2730	255	1	2730	255	10·5	5·2
Indian meal	2800	123	1	2800	123	10·2	10·8
Barley meal	2730	70	1	2730	70	10·5	19·0
Rye meal	2660	88	1¼	2128	70	13·5	19·0
Seconds flour	2660	120	1½	1773	80	16·2	16·6
Oatmeal	2800	140	2	1400	70	20·4	19·0
Bakers' bread	1995	90	1½	1330	60	21·6	22.1
Pearl barley	2660	91	2	1330	45	21·6	29·5
Rice	2730	70	2	1365	35	20·5	38·0
Potatoes	770	24	0½	1540	48	18·6	27·7
Turnips	238	13	0½	476	26	60·3	51·1
Green vegetables	420	14	0½	840	24	34·1	55·4
Carrots	385	14	1	385	14	74·8	95·0
Parsnips	421	12	1	421	12	66·4	110·8
Sugar	2800	—	5	560	—	51·2	—
Treacle	2200	—	1	2200	—	13·0	—
Buttermilk	335	35	0½	670	70	42·8	19·0
Whey	154	13	0¼	626	52	45·8	25·6
Skimmed milk	350	34	1	350	34	82·2	39·1
New milk	378	35	2	189	18	154·0	73·9
Skim cheese	2348	364	3	783	121	36·6	11·0
Cheddar do.	2520	315	8	315	39	91·1	34·1
Bullocks' liver	1226	210	3	408	70	70·3	19·0
Mutton	2902	140	5	580	28	49·5	47·5
Beef	2301	175	8	288	22	99·6	60·5
Fresh pork	2950	108	7	421	15	68·1	88·7
Dry bacon	4270	98	9	474	11	60·5	120·9
Green do.	3990	79	8	492	10	58·3	133·0
White fish	900	130	2	450	65	63·8	20·4
Red herrings	1435	217	4	359	54	80·0	24·6
Dripping	5320	—	6	887	—	32·3	—
Suet	4710	—	7	673	—	42·6	—
Lard	4819	—	9	535	—	53·6	—
Salt butter	4585	—	12	382	—	75·1	—
Fresh do.	4712	—	16	294	—	97·6	—
Cocoa	3934	140	4	983	35	29·2	38·0
Beer and porter	315	1	1	315	1	91·1	1330·0

And now we may proceed to examine in detail the general properties and the nutritive qualities of different foods.

Primarily, all our foods are derived from the vegetable kingdom, for no animal has the physiological power of associating mineral elements and forming them into food. What we may yet do by means of chemical agencies in the laboratory is another question; but within our own bodies there is no faculty for such conversion. As I shall hereafter explain to you, our functions are of an opposite kind. We are destructive creatures, not constructive. It is our province to pull down what the vegetable has built up; to let loose the affinities which the plant has brought into bondage, and to restore to inanimate nature the matter and cosmical force which the growing plant had taken from her.

Foremost, therefore, of our foods are those which come at once from the vegetable kingdom; and of these the cereals are the most important, as wheat, barley, oats, rye, maize, or Indian corn, rice, millet or durra, and Guinea corn.

Wheat.—Different species of this grain are cultivated, but the most common in this country is *Triticum vulgare*, of which there is a summer and winter variety.

The grain varies a good deal in composition according to season, climate, and soil; but, as a rule, the wheat of southern climates and warm seasons is richer in gluten, and of harder texture than that of colder climes. They are then called stronger grains, although the latter, from their being softer and kinder, give a larger proportion of flour. Some of the hardest varieties of wheat, as rivets, are used to strengthen the flour of new grain, which is always unmanageable, and to improve that of bad seasons and of damaged quality.

The structure of the grain is like that of all the cereals; there is an outer siliceous and woody covering, which is altogether valueless as food; then there is a layer of rich nitrogenous matter, containing a digestive body called cerealine, and within that is the flour, which forms the great bulk of the seed.

When ground whole, it forms brown meal, which is rarely used in England at the present time, although it was the common food of our forefathers, and even now is much employed in Westphalia to make the dark-coloured bread called pumper-nickel. It contains from 5 to 12 per cent of indigestible matter, in the form of bran, the removal of which, according to Liebig, is only a refinement of luxury.

The practice at the present time is to bolt or sift the ground meal through sieves, or silks, of different degrees of fineness, and thus to remove the coarser bran. The products have different names in different places, and have also different values; but generally 100 lbs. of wheat will yield from 78 to 80 parts of good serviceable flour. The other products are about 2 parts of specks, or tails, or tippings; from 2 to 3 parts of sharps; about 3 of fine pollard; from 3·5 to 6 of coarse pollard; and from 4 to 10 of bran. The relative wholesale values of these are about as follows:—

Vegetable Foods.	lbs. per bushel.	Price per bushel.		Price per 20 lbs.	
		s.	d.	s.	d.
Fine flour	56	10	0	3	7
Seconds ditto	56	7	9	2	9
Sharps	26	2	0	1	6
Fine pollards	18	1	0	1	1
Coarse ditto	14	0	10	1	2
Bran	12	0	9	1	3

Seconds flour is practically the best for domestic use; and of this there should be at least 80 per cent obtained from the grain. Attempts have often been made to increase the produce; for as the bran contains a good deal of nitrogenous matter, and is, moreover, rich in fat and saline substances, it has been thought wasteful to remove it; but the experimental researches of Poggiale, the learned professor at Val-de-Grace, have shown that at least 50 per cent of the bran is perfectly indigestible, and may be passed successively through the bodies of four or five animals without undergoing change. It, moreover, acts as an irritant; and, by hurrying the food through the alimentary canal, is very likely to cause waste. Those who labour hard, as railway navigators, invariably choose the whitest bread for food, believing that it is not only more digestible, but it is stronger, and will enable them to do more work. Without doubt, however, there is room for improvement in the treatment of flour, and in the complete utilisation of its several constituents. M. Mège Mouries has invented a process whereby the outer skin only of the wheat may be removed, and from 86 to 88 per cent of flour realised. The process was examined in 1857, and reported very favourably of by Dumas, Pelouze, Payen, Peligot, and Chevreul, but I am not aware that it has come into use.

M. Mège Mouries also directed attention to the fact that the bran contains a portion of very soluble nitrogenous matter, cerealine, which is of the nature of diastase, and has the property of dissolving starch. This, no doubt, might be utilised by treating bran with warm water, and then using the water in the manufacture of bread.

The nutritive value of wheat is shown in Tables No. 3 and No. 4; and although the average amount of gluten is there set down at about 11 per cent, it ranges from 8 to 15 per cent—the largest quantity being found in the wheaten flour of India, Egypt, South America, and the South of Europe.

It appears, too, that the quantity of gluten, as represented by nitrogen, increases with the coarseness of the flour, and so, also, does the amount of mineral matter.

TABLE V.

Percentage amounts of Nitrogen and Mineral Matter in the different Products of the Mill:—

	Nitrogen	Mineral matter.
Fine flour	1·70	0·71
Tails	1·86	0·99
Fine sharps	2·21	1·89
Coarse do.	2·58	3·80
Fine pollard	2·44	5·50
Coarse do.	2·42	6·50
Bran	2·39	7·00
Average in whole grain	1·82	1·62

The starch and sugar amount to about 70·5 per cent, and the fat to 1·7; so that the carbonaceous is to the nitrogenous as 6·7 to 1, which is a good proportion. Other facts relating to its nutritive value are shown in Table No. 4.

The tests for a good flour are its sweetness and freedom from acidity or musty flavour; and its nutritive value, as far as gluten is concerned, is estimated by the process of Beccaria, who discovered gluten in wheat more than a century ago. A given weight of flour (say 500 grains) is made into a stiff dough, and is carefully washed by tender manipulation under a small stream of water. The gluten remains, and when baked it expands into a clean-looking ball, which should weigh, when thoroughly dried, about 54 grains.

Of all the preparations of flour, bread is the most important. I shall hereafter describe the process of making it, but I may here remark that it should not contain more than from 36 to 38 per cent of water, and the other constituents, excepting salt, should be the same as of good flour.

In practice, 100 lbs. of flour will make from 133 to 137 lbs. of bread, a good average being 134; so that a sack of flour of 286 lbs. should yield 95 four-pound loaves. The art of the baker, however, is to increase this quantity, and he does it by hardening the gluten through the agency of a little alum, or by means of a gummy mess of boiled rice, 3 or 4 lbs. of which will, when boiled for two or three hours in as many gallons of water, make a sack of flour yield 100 four-pound loaves. But the bread is dropsical, and gets soft and sodden at the base where it stands. A good loaf should have the following characters:—

Kindness of structure—that is, not chaffy, or flaky, or crummy, or sodden; and
Sweetness to the palate and to the smell.

Wheaten bread is best eaten on the day after it is baked, for new bread is difficult of mastication, and still more difficult of digestion, because of its gummy nature. When it becomes stale it does not really get much dryer, but it undergoes a molecular change, which may be restored by heating the bread in a closed vessel to a temperature of 212°.

Wheaten bread is preferred to all other varieties of bread, because of its sweetness, and because it may be eaten alone. The nutritive constituents of it are in the same proportion as in wheat—namely, as 1 to 6·5, and a little more than 2 lbs. of bread will supply the requirements of the system; although, as I shall hereafter explain, it cannot be used alone, without loss of health and strength.

Barley-meal is the chief food of a large number of people in the North of Europe and in the South of England, where the labourer is partly paid his wages in meal or grain. It is also used in Wales and Scotland, especially in winter time, when wheaten bread is dear; and to some extent in Ireland. It is employed by about 90 per cent of the outdoor labouring population of England. At the time of Charles I. (in 1626), according to McCulloch, it was the usual food of the ordinary sort of people; and as late as the middle of the last century hardly any wheat was used in the northern counties of England. In Cumberland the principal families used only a small quantity about Christmas-time; and the crust of the everlasting goose pie, which adorned the table of every country family, was invariably made of barley-meal.

The grain is almost always ground whole, and the farina has much resemblance to wheaten flour; but the amount of gluten is very different—in fact, the nitrogenous matter, which amounts to about 6 per cent, is chiefly in the form of albumen—hence, the bread is heavy and compact, for albumen will not vesiculate or sponge like gluten. The common way of making it into bread is by mixing it with an equal proportion of wheaten flour; and sometimes it is mixed with oatmeal and rye-meal, and baked into cakes. But the best way of using it is in the form of thick gruel or stirabout, which is made by stirring the meal into boiling water.

Pearl Barley and *Scotch Barley* are the grain deprived of its husk, and rounded by attrition. The former is more carefully prepared than the latter, but both are used to give consistence to broth.

The nutritive value of barley meal is somewhat inferior to that of wheaten flour, but as the meal is cheaper than flour, it is more economical to use it; in fact, it is almost the cheapest article of diet, as may be seen by reference to Table No. 4.

Oatmeal and rye-bread were once the chief diet of the servants of the wealthy, and even now the former is used by 90 per cent of the agricultural labourers of England, and by a still larger proportion of the Scotch. The grain is very rich in gluten and fat, and it contains a good quantity of sugar and starch, the microscopic form of which is remarkable. The Scotch meal is always preferable to the English, on account of its higher nutritive power. It is prepared by grinding the kiln-dried grains, previously deprived of their skins. The Scotch grind it rather coarsely as compared with the practice in England.

Oatmeal is not nearly so white as wheaten flour, and its taste is peculiar, being at first sweet, then rough and bitter. Like barley-meal, it cannot be vesiculated into bread, but it makes good cakes, and these may be highly leavened, as is the custom in Yorkshire, or unleavened, as in Scotland.

The common method of cooking it, however, is by stirring it into boiling water until it has the consistence of hasty pudding, and in this manner porridge is made; but if it be afterwards boiled for a short time it makes Scotch brose. In Ireland it is mixed with Indian meal, and then stirred into boiling water, thus making the mixture called stirabout.

The decorticated grain constitutes grits or groats, and when these are crushed or bruised they go by the name of Emden groats. The sole use of them is for making gruel, a drink that seems to have been a favourite with our forefathers; for in the *London Gazette*, for Friday, August 13, 1695, there is an advertisement to the effect that water-gruel was always ready at the Marine Coffee-house, in Birchin-lane, Cornhill, every morning from six to eleven o'clock; and, it added, that as much as from four to five gallons of it were consumed there daily.

The husks of the grains are sold in Scotland under the name of seeds, and these, when steeped in water for a few days, until they become a little sour, like stale brewers' grains, and then squeezed out, produce a liquid which, when boiled down to the consistence of gruel, makes the food called flummery or sowans in Scotland, and sucan in South Wales. If it be boiled still more, until it becomes as thick as jelly, it forms budrum, or brwchan, as it is named in Wales. Oatmeal is, no doubt, rather hard of digestion, and causes irritation of the bowels. There is a notion also that it produces heat and irritation of the skin; and formerly, when sufficient care was not taken to remove the husk from the grain before it was ground, it was not an uncommon occurrence to find calculi or concretions of phosphate of lime, mixed with the silky bristles of the grain, in the alimentary canal. Somewhat similar concretions are found at the present time in the bowels of horses that feed too freely on bran or grains. The nutritive value of oatmeal is shown in Tables No. 3 and No. 4, and it will be noticed, that although it is, weight for weight, more nutritive than wheaten flour, yet, considering its price, it is not so economical.

Rye meal is the chief food of northern nations, and was once a common article of diet with ourselves. It forms the dark-coloured and sour-tasting bread of the North of Europe. In this country it is rarely eaten alone, but it is mixed with about twice its bulk of wheaten flour, forming what in many places is called maslin, and is then made into bread. The nutritive power of rye-meal is a little less than that of flour, and the proportion of the nitrogenous to the carbonaceous constituents is as 1 to 9·4.

(To be continued.)

MISCELLANEOUS.

The British Association.—The arrangements of the British Association for the Advancement of Science in connexion with its Norwich meeting have now made great progress. The first general meeting will be held in a building known as the "drill hall," erected for the local Volunteer corps, on Wednesday, the 19th inst., when the Duke of Buccleuch will resign the chair, and Dr. Hooker, the president of the year, will assume the presidency and deliver an address. The sectional meetings will be held on Thursday, August 20; Friday, August 21; Saturday, August 22; Monday, August 24; and Tuesday, August 25. The various sections will hold their meetings as follows:—Mathematical and physical science, Lady-lane lecture-room (president, Professor Tyndall); chemical science, Chapel-in-the-Field School (president, Professor Frankland); geology, Mr. Noverre's room (president, Mr. R.A.C. Godwin Austen); biology, the Friends' Meeting (president, the Rev. J. M. Berkeley); geography and ethnology, St. Peter's-hall (president, Captain Richards); economic science and statistics, in the Museum (Mr. S. Brown, president of the Society of Actuaries); and mechanical science, Free Library (president, Mr. G. P. Bidder, C.E.). On Thursday evening, August 20, a soirée will be held in St. Andrew's-hall, and on the following evening a discourse will be delivered in the drill-hall by the Rev. J. Ferguson, F.R.S., on "the Archæology of Early Buddhist Monuments." On the Monday evening a discourse will be delivered in the drill-hall by Mr. W. Odling, on "Reverse Chemical Actions;" and on the Tuesday evening there will be another soirée in St. Andrew's-hall. The concluding general meeting will be held in the drill-hall on Wednesday, August 26.

Sir James Y. Simpson on Medical Progress.—At the close of the ceremony of "capping" the medical graduates of the University of Edinburgh, on Saturday, Sir James Simpson delivered an address. In the course of his remarks, he said:—"A most extensive field for new investigations lies temptingly open for the young and ambitious physician in the almost innumerable series of new chemical compounds which modern organic chemistry has evolved. Among this world of new compounds will probably be yet detected therapeutic agents more direct, more swift, and yet more sure in their action than any which our present pharmacopœias can boast of. It may be, also, that the day will yet come when our patients will be asked to breathe or inspire most of their drugs instead of swallowing them; or at least when they will be changed into pleasant beverages instead of disgusting draughts and powders, boluses, and pills. But that day of revolution will not probably be fully realised till those distant days when physicians—a century or two hence—shall be familiar with the chemistry of most diseases; when they shall know the exact organic poisons that produce them, with all their exact antidotes and eliminatories; when they shall look upon the cure of some maladies as simply a series of chemical problems and formulæ; when they shall melt down all calculi, necrosed bones, &c., chemically, and not remove them by surgical operations; when the bleeding in amputations and other wounds shall be stemmed, not by septic ligatures or stupid needles, but by the simple application of hæmostatic gases or washes; when the few wounds then required in surgery shall all be swiftly and immediately healed by the first intention; when medical men shall be able to stay the ravages of tubercle, blot out fevers and inflammations, avert and melt down morbid growths, cure cancer, destroy all morbific organic germs and ferments, annul the deadly influences of malaria and contagions, and by these and various other means markedly lengthen out the average duration of human life; when our hygienic condition and laws shall have been changed by State legislation, so as to forbid all communicable diseases from being communicated, and remove all causes of sickness that are removable; when the rapidly increasing length of human life shall begin to fulfil that ancient prophecy, "the child shall die an hundred years old;"—when there shall have been achieved, too, advances in other walks of life far beyond our present state of progress; when houses shall be built and many other kinds of work performed by machinery, and not by human hands alone; when the crops in these islands shall be increased five or ten fold, and abundance of human food be provided for our increased population by our fields being irrigated by that waste organic refuse of our towns which we now recklessly run off into our rivers and seas; when man shall have invented means of calling down rain at will; when he shall have gained cheaper and better motive powers than steam; when he shall travel from continent to continent by submarine railways, or by flying and ballooning through the air; and when—to venture on only one illustration more—tiresome graduation addresses shall no longer require to be written by old professors nor listened to by young physicians."

Experiments with Dynamite.—This new blasting powder is meeting with flattering success in the hands of miners and quarrymen. The following account of some recent interesting experiments by the inventor himself, Mr. Nobel, of Hamburg, which we copy from the *Glasgow Journal*, will no doubt be read with great interest at this time. The experiments took place in Messrs. Faill's Ladywell quarry, and in the presence of a large number of civil and mechanical engineers, contractors, and quarrymen. Mr. Nobel commenced by showing the dynamite itself to be perfectly safe in use, by cutting a cartridge in two and burning one part, holding it in the hand all the time. The other half was shown to contain explosive material by the ordinary mode of firing it by percussion caps. Another experiment illustrating how safely it might be used was by throwing from the most elevated part of the quarry, about fifty or sixty feet high, a box filled with the powder. The box broke, and the dynamite was scattered about, but no explosion followed from the concussion. Another box, equally charged in the same way, was burned in a large open fire kindled on the ground, but no explosion followed. There was another experiment to illustrate the fact that the material might be exploded without enclosing it in a cartridge case or any confined place. It was laid on the end of a plank, and the percussion cap, on the end of a fuse, was made to explode in contact with the loose powder. The plank itself was shattered with a very loud report. Its power as a blasting agent was tested on the solid whinstone rock. One bore hole was made in the face of the rock, fourteen feet deep, fifteen feet from the face at right angles, and fifteen feet from the surface of the ground. The diameter of the bore was one and a half inch at bottom. This was charged with six pounds weight of the dynamite, and filled about four feet of the hole. The outer portion of the bore hole was stemmed loosely with sand. About 4,000 cubic feet of rock were actually displaced, and perhaps twice as much loosened. Another blast was made at the bottom, on the face of the quarry wall, nine feet six inches deep, and about one inch and a half in diameter at the bottom, which was charged with six pounds of dynamite; and this in what the foreman of the quarry had selected as the strongest rock that the quarry could supply him. The rock in this case was ruptured from the bottom to the very top, between forty and fifty feet in height. So thoroughly was it broken that the quarrymen had simply to use the crowbars to remove the masses of rock. The workmen all said that gunpowder could not have produced such an effect. The utility of the dynamite for distress signals at sea was tested twice; in the first case with seven ounces, and in the second with about one pound into a cartridge, suspended from a cord stretched across the quarry. On both occasions the report was very loud, the second of the signals being heard reverberating into the town. The power of the dynamite was also tested upon masses of wrought iron successfully. A large mass of wrought iron was fixed vertically in the ground, the top of which was nine inches in diameter, and distinctly convex. About five pounds of dynamite were placed upon the top, and an explosion effected. The result was the production of a distinct concavity, and an increase in diameter of nearly three-quarters of an inch, and ruptured all over the surface. In order to show the applicability of the dynamite for charging shells to be used with destructive effect upon iron-clads or casemated fortresses, a wooden cylinder with a three-inch bore was charged with dynamite and laid upon the side horizontally. Upon the bottom end of the cylinder was tacked a disc of tin plate. Opposite the tin plate, and about eighteen inches from it, were placed two pieces of boiler, three-eighths of an inch thick—being a cutting from some plates supplied by the Parkhead forge for Government contract. The strength of it, per specification, was twenty-four tons per square inch. The result was that with about eight ounces of dynamite, a piece of tin plate was projected through both pieces of boiler plate. Great satisfaction was expressed at the result of the experiments, both by the many practical persons who were present on the ground as visitors, and by the proprietors of the quarry and their workmen.—*American Journal of Mining.*

CONTEMPORARY SCIENTIFIC PRESS.

Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Comptes Rendus.

June 15, 1868.

A. Wurtz, "On a new Isomer of Amylic Alcohol." Secchi, "Remarks on Prasmowski's Note on the Spectrum of Brorsen's Comet." A. Tripier, "On the Use of Anæsthetics, in Attacks of Hepatic Colic." P. de Clermont, "On a new Alcohol isomeric with Caprylic Alcohol." A. Gautier, "On the Carbylamines." E. Filhol, "Researches on Chlorophyl." A. Scheurer-Kastner and C. Meunier, "Researches on the Combustion of Coal from Saarbruck, Rhenish Prussia."

June 22, 1868.

P. A. Favre, "Researches on Electrolysis" (Continuation). P. Desains, "On the Use of a Pile of Plates of Rock Salt for Obtaining Polarised Heat in Researches on Obscure Radiation." J. Jamin and Roger, "On the Laws of Induction." Sidot, "On the Preparation of Sulphides of Iron and Manganese." F. Isambert, "Researches on the Dissociation of certain Double Chlorides of Ammonium."

June 29, 1868.

Daubree, "Note on the Author's Work 'Synthetic Experiments on Meteorites.'" Secchi, "On the Spectrum of Winnecke's New Comet." G. Magnus, "On the Diathermancy of Chloride of Potassium." L. Dusart and E. Pelouze, "Contributions to the Knowledge of Phosphate of Lime." A. Houzeau, "On the Action of Iodide of Potassium on Ether." C. Wolf, "On the Spectrum of Winnecke's New Comet." H. Debray, "On the Vapour-Density of Calomel." P. Schutzenberger, "Researches on the Action of Dry Hypochlorous Acid Gas on a Mixture of Iodine and Acetic Anhydride." Robinet, "On the Property possessed by Oxygen of causing Ignited Bodies to Flame."

Monatsbericht der Königlich Preussischen Akademie der Wissenschaften zu Berlin.

March, 1868.

Magnus, "On the Polarisation of Heat of 100°, and on the Oscillations which accompany the Conduction of Heat." J. C. Poggendorff, "On a Peculiar Instance of the Electric Conductivity of Glass." Hoffmann, "On the Composition of Persulphide of Hydrogen."

Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften zu Wien. (Mathematisch-Naturwissenschaftliche Classe.)

Division 2.

January-February, 1868.

W. Reitz, "On the Passage of Cinnabar through the Animal Body." E. Mach, "On the Effect of Different Modes of Lighting on the Apparent Form of Objects." E. Brucke, "On the Detection of Ammonia in Animal Fluids, and on the Behaviour of the same in some of its Compounds." A. Waszmuth, "On the Currents in Secondary Combinations in Voltaic Batteries." J. E. de Vry and E. Ludwig, "A Chemical Investigation of the Latex of *Antiaris toxicaria.*" Rochleder, "Note on Pectous Substances." A. Bauer and E. Klein, "Note on the Action of Tetra-chloride of Tin on Amylic Alcohol." R. L. Maly, "Researches on the Colouring Matters of Bile." A. Handl, "On a new Method of Observing Syphon Barometers." A. Bauer and E. Verson, "Contributions to the Knowledge of Benylene." E. Hering, "Contributions to the Knowledge of the Vitality of Blood Corpuscles."

Bulletin de l'Académie Imperiale des Sciences de St. Petersbourg.

March 7, 1868.

P. Alexeyeff, "Contributions to the Knowledge of Azobenzide." F. Beilstein and A. Kuhlberg, "On Isomeric Dichlortoluols and Trichlortoluols." De Jacobi, "Report on the various Processes for Electro-deposition in Use at J. M. van Kempen's Works at Voorschoten, with Particular Reference to a Method of Depositing a Silver Ornamental Vase in a Single Piece."

Journal fur Praktische Chemie.

May, 1868.

W. L. Clasen, "On the Action of Water and of various Neutral Saline Solutions on Cane Sugar." C. Scheibler, "Note on the Presence of Metapectic Acid in Beetroot." J. Lowe, "On the Formation of Ellagic Acid from Gallic Acid." P. Bolley, "A Comparison of the Hygroscopic Properties of Raw Silk and of Silk which retains its Coating of Natural Gum. On the Adulteration of 'Tin Salts.' On the Quantitative Estimation of the Unsaponified and Neutral Fat contained in Soaps. Contributions to the Knowledge of Curcuma. On a Green Dye-stuff from the Territory of Senegal, West Africa. On Peroxide of Manganese from Romanèche, Saône-et-Loire, France. On some Properties of Paraffin, and on Paraffin Baths. On Obtaining Gallic Acid and Pyrogallic Acid from the Tannin of Sumach. On J. Fuchs's Process for Estimating Nitric and Nitrous Acid in Water. On E. T. Chapman's Remarks on Nessler's Test for Ammonia. On the Estimation of Potash in Alkaline Solutions. On the alleged Dryness in Spaces warmed by means of Hot Air, and on the Circulation of Air under such Circumstances." Weselsky, "On the Preparation of Double Cyanides of Barium.

June, 1868.

F. Goppelsroder, "On a Fluorescent Substance derived from Fustic, and on the Analysis of Fluorescent Substances in general." R. L. Maly, "Researches on the Colouring Matters of Bile."

Bulletin de la Société Chimique de Paris.

June, 1868.

E. Bourgoin, "On the Electrolysis of Malic Acid. On the Electrolysis of Benzoic Acid." E. Fremy and Terreil, "On a General Method for the Direct Analysis of Vegetable Tissues." Terreil, "On the Action of Saline Solutions on Minerals." A. Descamps, "On the Double Cyanides analogous to Ferrocyanides and Ferricyanides." Berthelot and Jungfleisch, "Comparative Researches on Perchlorinated Benzine, Perchlorinated Naphthaline, and Julin's Chloride of Carbon." Berthelot, "On the Transformation of Dibasic into Monobasic Acids. On a Modification of the Author's new Thermometer for measuring High Temperatures. On Pyrogenous Hydrocarbons." M. Galetti, "A Simple Method of Removing Hydrochloric Acid from Commercial Nitric Acid."

Le Technologiste.

June, 1868.

A. Bance, "An Improved Process for Dyeing Turkey Red.' Bernard, "On the same Subject." A. Cordier, "On the same Subject." W. Schultze, "Researches on the Formation of Lactic Acid during the Fermentation of Distillers' Worts." "A Process for the Extraction of Silver from Black Copper." Reichert, "On Obtaining Magnesium from Carnallite."

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2040. E. B. Wilson, Stockton-on-Tees, Durham, "Improvement in furnaces."—Petition recorded, June 24, 1868.

2251. J. Dugnid, jun., Glasgow, N.B., "Improvements in the manufacture of paper, and in the means employed therefor."—July 17, 1868.

2261. D. Webster, Southport Gas Works, Lancashire, "Certain improvements in the manufacture of gas, and in apparatus connected therewith."

2265. J. Thomas, Newcastle-on-Tyne, "Improvements in furnaces for smelting and melting."—July 18, 1868.

2277. T. G. Green, Church Gresley Pottery, Derbyshire, "Improvements in the preparation or manufacture of a composition intended to be used in the manufacture of earthenware, porcelain, or vitreous articles."

2278. L. Rose, Leith, Edinburgh, "An improved aërated liquid, or artificial champagne."—July 20, 1868.

2289. A. A. Wille, Woodford, Essex, "Improvements in bleaching or extracting the colour from feathers."—July 21, 1868.

2293. T. Gibb, Jarrow-on-Tyne, Durham, "Improvements in the treatment of metallic ores and compounds."

2294. G. Martin, Toadsmoor Rock Mills, near Stroud, Gloucestershire, "Improvements in the manufacture of extract wool, and in the process and apparatus employed in destroying the vegetable material in mixed fabrics, which apparatus is applicable for other purposes."

2297. S. Langdale, Newcastle-upon-Tyne, "Improvements in the preparation of artificial manures."—July 22, 1868.

2314. P. Pearson, Leeds, "Certain improvements in the treatment and preparation of cocoa."

2321. J. Kilner, Wakefield, Yorkshire, "An improved method of and apparatus for manufacturing glass."—July 23, 1868.

2329. G. A. Thibierge, Versailles, France, "Improvements in preserving animal and vegetable substances."—July 24, 1868.

INVENTION PROTECTED BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

2440. H. A. Bonneville, Chaussée d'Antin, Paris, "A new and improved process for preserving meat, and the apparatus connected therewith."—A communication from W. Wiesmann, Bonn, Prussia.—Petition recorded August 4, 1868.

NOTICES TO PROCEED.

1010. A. B. Wollaston, Chislehurst, Kent, and F. Stanbridge, Llangarron, Herefordshire, "Improvements in the treatment of mixed fabrics, and in the separation of wool from cotton and other substances contained therein."—Petition recorded March 21, 1868.

1263. A. P. Price, Lincoln's Inn Fields, Middlesex, and J. A. Wanklyn, Finsbury Circus, "Improvements in the preparation and use of anæsthetics."—April 17, 1868.

1336. J. Rogers, Baxter Road, Islington, "Improvements in the preparation and utilisation of certain vegetable and bituminous products."—April 23, 1868.

1630. E. P. H. Vaughan, Chancery Lane, "Improvements in the preparation of anhydrous chlorides by means of sulphides or their elements."—A communication from P. Curie, Bordeaux, France.—May 19, 1868.

2048. Rev. H. Highton, M.A., Sussex Square, Brighton, Sussex, "Improvements in the manufacture of artificial stone or slate, and in colouring the same."—June 25, 1868.

2340. C. D. Abel, Southampton Buildings, Chancery Lane, "A new or improved process for separating the zinc from the argentiferous alloys obtained in the separation of silver from argentiferous lead by means of zinc, and improvements in the furnaces employed for that purpose."—A communication from H. Roux, Marseilles, France.—July 25, 1868.

NOTES AND QUERIES.

Can any correspondent of the Chemical News inform "Nindex" where he can obtain liquid carbonic acid, and the price of the same; also, where he can obtain second-hand philosophical apparatus?

Lubricating Composition.—In reply to "Aberkenfig," the best lubricating composition for heavy work is a mixture of railway grease and plumbago. A sailor introduced the above into the Portuguese navy; it proved efficacious, and the government granted him a pension.—Hirst, Brooke, & Hirst.

Gallipoli Oil.—Expose the oil to light and air; at the same time allow it to remain perfectly quiet for several days—if the oil be very foul, weeks may be necessary. It is a mere matter of time; the oil will sure to become clear in the end—filtering through charcoal will slightly accelerate the operation. There are no dyes used in colouring wool that will permanently stain oil. The aniline colours appear at first to colour oil, but in a short time are deposited, and the oil is as clear as ever. Query:—What will colour oil *permanently*, of any colour or shade, alkanet root excepted?—S. P.

Separation of Earthy Sulphates.—Prolonged digestion with a solution of carbonate of ammonia at the ordinary temperature will change sulphates of strontia and lime into carbonates, without acting on sulphate of baryta. A boiling temperature, or the employment of carbonate of soda, does not effect so complete a transformation. The mixture of salts so obtained should be finely pulverised and well washed in cold water before treatment with nitric acid; this then dissolves the strontia and lime and leaves the sulphate of baryta. Neutral lime salts treated with a solution of arsenious acid, give a precipitate of arsenite of lime on addition of ammonia. Salts of strontia and baryta under the same circumstances give no precipitate.—F. Wöhler.

TO CORRESPONDENTS.

L. Pokorney.—We are acquainted with no better cement for iron than the well known mixture of iron filings, sulphur, and sal ammoniac.

Sea-Side.—A short account of the chemistry of shells appeared in Brande's "Manual."

H. Swinstone.—The cinnamon stone is sometimes used as a gem. It consists essentially of a silicate of lime and alumina, containing a little iron.

Manager, G.—The substitution of lime, by zirconia in the oxyhydrogen light, has been carried out by the inventor, M. Caron, on a sufficiently large scale to show its entire practicability. The expense of zirconia would doubtless diminish as soon as a demand arose for it. It is a rare earth at present because nobody wants it.

Communications have been received from Messrs. Townsend and Adams; Louis Pokorney; S. Mellor; Prof. Heaton; J. T. Dafter; F. A. Aramayo; W. Leighton; E. Smith; G. Dutton; F. J. Harker (with enclosure); M. A. Baines; Mawson and Swan; Prentice and Co.; J. L. Denman; R. Wardrop; J. Parry; Rev. B. W. Gibsone; Street Bros.; J. Noble; J. Bowing; J. Spiller; Spottiswoode and Co.; and Dr. Röhrig.

BOOKS RECEIVED.

Condensed Temperance Facts for Christians, with remarks on Ancient and Modern Wines and Malt Liquors. By J. Mackenzie, M.D. London: Trübner.

Britain's Drawbacks. By Rev. Professor Kirk.

Water, its Impurities and Purification. By the London and General Water Purifying Company.

Development and present state of Dreher's Breweries. Vienna, 1868.

THE CHEMICAL NEWS.

Vol. XVIII. No. 455.

ON THE EXTRACTION OF OIL BY MEANS OF SULPHIDE OF CARBON.

By M. HEYL.

A new and interesting process for the extraction of oil by means of sulphide of carbon is carried out on a large scale at the manufactory of M. E. O. Heyl, at Moabit, near Berlin.

With respect to this method, the annals of Prussian agriculture contain details which we now transcribe. An oil of sufficiently good quality for successful employment in the lubrication of machinery, is manufactured at Moabit at the daily rate of 2,570 kilogrammes; its residue forming an excellent food for cattle. When more or less finely ground, the latter may be sent off in sacks, and requires no pulverisation before being mixed with hard or soft water, but may be given to the animals at once, thus having an advantage over oil-cake. The oleaginous grain, such as colza, linseed, or mustard, arrives in ships by the Spree, and is raised into the warehouse by a perpetual screw, which every day draws up into the manufactory the necessary quantity for the work (about 33 hectolitres). It is then placed by a lift upon a sieve comprising a winnower, and thence falls, perfectly clean, into a triturator, the movements of whose cylinders are combined in such a way as to tear rather than bruise it.

After this preparation, the grain passes into a revolving cylinder of sheet iron, about 0·418 m. in diameter, and heated from below, whence it falls after desiccation into eight large vats, each holding 8·78 hectolitres, and capable of revolving on two horizontal axles.

After having carefully closed the vats with covers, the sulphide of carbon is conducted into them from a higher reservoir; about 7,000 kilos. being required for the daily manufacture, of which, however, only 28 kilos. are lost, that is to say about 4 per cent. From the bottom of the vat, the solution of oil in the sulphide of carbon trickles out in a thread-like manner, and becomes clearer, until at last the sulphide runs quite pure. This indicates the precise moment when the seed is completely deprived of oil, and steam is then substituted for the sulphide, of which it entirely removes all traces.

The vats are now uncovered and reversed, in order to eject the exhausted matter, which is taken up by the lifts and passed successively through three mill-hoppers heated by steam; lastly, it is again ground, when it forms an alimentary powder, containing 5·3 per cent of nitrogen, and saleable at 15·15 francs the hundred kilos. The mixture of oil and sulphide of carbon extracted from the vat washings is purified with steam, distilled twice, and cooled in three large worms passed through refrigerators. It is then rectified, which renders it capable of employment in new operations, after being restored to the original reservoir. The trade price of sulphide of carbon is from 0·79 fr. to 0·85 fr. the kilogramme, but costs the manufactory of Moabit rather less, as it is made on the premises. The oil thus obtained is sold as lamp oil after being deprived of colour; and by submitting it to a chemical process, a superior oil for purposes of lubrication is produced, possessing the advantage of being and remaining extremely fluid. Another oil is also manufactured, specially adapted to the lubrication of railway-carriage axles, inspissating at a very low temperature only. Four large wrought-iron reservoirs of 7·416 cubic metres each hold large quantities of oil, and a steam-engine of 12-horse power, with two boilers and a pressure of two atmospheres, give all the power and steam necessary for operation, transport, &c. The daily fabrication of 2,570 kilos. only requires the work of six men; and the careful analyses of MM. Birner, of Regenwalde, and Karsten, of Kiel, could only find in the residue 2 per cent of oil and 7 per cent of water, whilst in the residue from the common method of pressing, 9 per cent of oil and 15 per cent of water were discovered.

The question has been much discussed as to whether colza oil-cake be a beneficial food for cattle; it depends on the object in view. The experience of M. Strengeld of Tharand proves that when cattle are young and have not attained their full growth, the colza oil-cake is advantageous, as the growth of animals requires food richer in nitrogen and phosphoric acid than in fatty matter; it is also beneficial to milch cows. For fattening cattle, aliments richer in fatty matter are preferable. These remarks will explain the contradictory opinions held by different agriculturists.—*(Preussische Annalen der Landwirthschaft.)*

AIDE MEMOIRE FOR SILICEOUS FORMULÆ.

By the Rev. B. W. GIBSONE, M.A.

Neglecting the recent classification by Odling of the silicates into ortho-, meta-, ½, and acid, which distribution, though perhaps more philosophic, does not readily include some cases of common occurrence, we employ the well recognised formula—

$$pMO,qSiO_2 + rR_2O_3,sSiO_2 + tH_2O.$$

This general type may be made to embrace almost all the known earthy silicates (however complicated their composition) by giving variations to its constants.

Here M denotes Ca″, Mg″, Fe″, Mn″, &c., or K_2, Na_2, metals furnishing a protoxide, and R stands for Fe‴, Al‴, Cr‴, &c., metals furnishing a sesquioxide, the law of isomorphous substitution being supposed to prevail.

In every such formula five numerical constants—p, q, r, s, t,—have to be recollected, a mental exertion almost intolerable even to those most versed in minerals; yet examiners (according to my personal experience) sometimes call upon examinees to write down half a dozen such in a single sitting.

While strongly deprecating such a deplorable misdirection of students' energies, I beg to submit to the latter a mode of surmounting much of the difficulty.

Abstract numbers may be represented by consonant letters, and these latter may then be grouped by aid of vowels into intelligible words having some relation obvious or fanciful to their original.

Thus, adopting Howlett's system of memoria technica, and calling—

s or x	D	d or v	6
q or t	1	c or k	7
h or n	2	b or w	8
g or m	3	p or f	9
r or z	4	y	10
j or l	5		

such a long sequence of figures as 59221 might be recollected by the word *elephant*, or 92(10)75 by *physical*, the semiconsonant y being combined with the following consonant to form the symbol of any number from 10 to 19.

The following lines—some rational, some nonsensical—have stood the test of a few years' usage among my pupils, and contain the essentials worth remembrance, viz., the oxygen ratios of the constituents in the commonest natural siliceous compounds. In explanation I may add that the memorial words are italicised, and occur usually at the beginning or end of each verse.

Appended also are brief explanations designed to add intelligibility to a necessarily incoherent composition; they will, I diffidently hope, include some facts interesting to mineralogical students.

The atomic weights are the most recent.

Aluminous Silicates.

(1). *German* calls Garnet Idocrase;
(2). *Man* makes Staurolite; *grain* of clay's
(3). *(O tædium di!)* débris Felspar;
(4). *Rare gaze to duped* eyes Micas are;
(5). Heat Topaz and its tint will *fade;*
(6). Of *murder* Scapolite 's afraid
(7). And gLucy Beryl sweet *good maid,*
(8). Trapezal Leucite brings *them aid,*
(9). But *graver* Epidote can't come;
(10). Pol'd Tourmaline is *set in gum.*

(1.) *Hausman* calls Vesuvian garnet idocrase; this, the pyramidal form, is isomeric with the dodecahedral or common garnet, $3CaO,2SiO_2 + Al_2O_3,SiO_2$.

(2). Prismatic staurolite, Al_2O_3,SiO_2, has been formed *artificially* by Deville, who passed gaseous SiF_4 over alternate layers of Al_2O_3 and SiO_2.

Kaolin or clay in its pure form (as got from St. Austell, Cornwall) $Al_2O_3,2SiO_2 + 2H_2O$ is derived from the *disintegration* of Felspar by the weather.

(3). The felspars are a family *tedious* to enumerate; the member here quoted, potassium felspar or orthoclase, is monoclinic, the rest triclinic.

(4). The deceptive double refraction of the micas is of two kinds, viz., uniaxal in Mg mica, $4MgO,2SiO_2 + Al_2O_3,2SiO_2$ and biaxal in K mica, $K_2O,3SiO_2 + 3Al_2O_3,3SiO_2$.

(5). Topaz, according to Sir D. Brewster, contains an organic volatile hydrocarbon to which its colour is due. To a similar conclusion tend the researches of Lewy, Kuhlmann, Fournet in the case of other gems.

Topaz, $2Al_2O_3,2SiO_2 + Al_2O_3,SiF_4$, contains a variable amount of fluorine, here estimated as equivalent, oxygen, viz., $F_4 = O_2$.

(7). Beryl, $3GO,3SiO_2 + Al_2O_3,3SiO_2$, is a source of glucinum and its *sweet* (γλυκυς) salts.

(8). The *trapezohedron*, a variety of the icositetrahedron, is named by Rose leucitohedron from this mineral's form.

(10). Tourmaline is eminently polar both electrically and optically; when used in the polariscope it may be mounted in Canada Balsam.

Hydrated Aluminous Silicates.

(1). *Tune maiden* Analcime thy feeble lyre,
(2). While Mesotype searches *the mart* for a buyer.
(3). *Quid mi Dave!* see Stilbite's lustrous fire;
(4). The zeolyte Prehnite *ne'er meant* to proclaim
(5). *Them dead* to the fame of frail Chabazie's shame,
(6). Nor that green-slate became for Chlorite *our home name.*

(1). Analcime (*αναλκιτ*, weak), named from its feeble electric power.

(2). Mesotype, formerly natrolite.

(3). Stilbite's *lustre* (*στιλβη*) elicits the Latin exclamation of wonderment.

(5). Haüy terms this *fragile* and beautiful crystal chabasie.

(6). The *home* or trivial name of chlorite slate is green (*χλωροτ*) slate.

Magnesian Silicates.

(1). *Hail* Talc, and in Magnesian group
(2). *Gib* Steatite a part,
(3). *Never* smoke Meerschaum, or the croup
(4). Will *hurt* Picrosmine's *heart.*

(2).

(5). Proud Augite, Pyroxene, Hypersthene *queen*
(6). Has three titles, but Chrysolite Olivine *none,*
(7). Substitutive ferruginous Serpentine *green,*
(8). And tough Amphibole, Hornblende will finish *lay one.*

(1). Talc, $4MgO5SiO_2$.

(3). Meerschaum, $2MgO,3SiO_2 + 4H_2O$.

(4). Picrosmine (*πικροτ*, pungent, *οσμη*, odour) has an argillaceous scent when moistened; several of this group also, *e.g.*, steatite or soapstone, are unctuous to the touch.

(7). A trace of Fe replaces the Mg in serpentine, producing the deep green and red tints.

ON THE ACTION OF SULPHUROUS ACID ON COMPOUNDS OF SILVER.

By Professor J. S. STAS.

I WILL give here, generally, the observations I have made on the action which sulphurous acid has upon silver compounds, according as the acid is intact or has undergone a decomposition.

A current of sulphurous anhydride, prepared by means of the combustion of sulphur in dry air, or by the decomposition of sulphuric acid by copper, mercury, carbon, or wood, produces a *white* precipitate of sulphite of silver in an aqueous solution of nitrate or sulphate of silver; the liquid remains colourless.. A solution of sulphurous acid, newly obtained by passing the anhydride through boiled water, and *protected from the action of the light*, behaves like the anhydride. The sulphite of silver produced, kept from the light, seems to me to keep indefinitely at common temperatures; but under the influence of light, or of an excess of sulphurous acid, it changes into a mixture of sulphate of silver and metallic silver.

A current of sulphurous anhydride, or a fresh saturated aqueous solution of this anhydride does not precipitate sulphite of silver from a solution of nitrate or sulphate of silver, dissolved in water acidulated by a sufficient quantity of sulphuric or nitric acid; *the liquid remains colourless.* In *complete darkness*, the liquid may even be kept for a long time at 100° C., without the slightest precipitate or change of colour.

A solution of sulphurous acid in pure water, whether boiled or not, after being left for some time in the light, gives a *grey* precipitate with sulphate and nitrate of silver; in a few moments the supernatant liquid becomes successively yellow, brown, and black, and at length throws down sulphide of silver.

I have seen such a solution of altered sulphurous acid, precipitate, in darkness, metallic silver from a solution of nitrate or sulphate of silver in dilute sulphuric acid, and even in dilute nitric acid.

It is therefore seen that, under certain circumstances, a solution of sulphurous acid will act on nitrate and sulphate of silver as do most of the polythionic acids, which slowly precipitate sulphide of silver from solutions of these salts. H. Rose has already noticed that sulphurous anhydride, obtained by the action of sulphur on binoxide of manganese, behaves in respect to soluble salts of silver differently from an acid produced by the reduction of sulphuric acid with mercury or copper, even after having deposited, by sufficient repose, the sulphur which it may have carried over. I have recognised the same fact, but in a less degree, with the sulphurous anhydride obtained by the action of sulphur on sulphuric acid. In fresh solution they both behave like very dilute solutions of pentathionic acid; they precipitate from nitrate of silver a mixture of sulphite, sulphate, and sulphide of silver.

The same difference which I have observed in the action of *intact* and *altered* sulphurous acid on nitrate and sulphate of silver dissolved in pure water, or in water acidulated with sulphuric or nitric acid, I have observed in the reducing action which these intact or altered acids exert on the iodate, bromate, and chlorate of silver. *At a low temperature, and in perfect darkness*, both sulphurous anhydride and its solution, made at once away from the light, reduce to the state of iodide, bromide, and chloride the iodate, bromate, and chlorate of silver suspended in pure water or in water acidulated with sulphuric acid. Whatever may be the excess of sulphurous anhydride, or its solution, the pale yellow iodide, the bromide, still paler sometimes, and dark yellow at other times, and the white chloride remain absolutely intact, and all their elements remain insoluble for an indefinite time, if these compounds are absolutely withheld from direct or indirect solar radiation. We may even raise to 100° C., and keep for a long time at this temperature, the liquids in which the iodide, bromide, and chloride of silver rest by the side of the sulphurous acid, without their experiencing the least alteration.

The liquid in which the iodide, bromide, or chloride of silver is precipitated, contains no trace of iodhydric, bromhydric, or chlorhydric acid. On the other hand, under the influence of light and sulphurous acid, the iodide of silver, slowly becomes *greyish*, the bromide very rapidly becomes blackish, and the chloride very rapidly bluish black; in this case the liquids contain, respectively, iodhydric, bromhydric, and chlorhydric acids. When, in consequence of the presence of air, the sulphurous acid has passed to the state of sulphuric acid, the iodide of silver which had become *grey* regains its *yellow* colour, as the iodhydric acid brings it back to the state of iodide, and the iodide keeps yellow because it is unalterable by *light alone*, whilst the blackish bromide and the bluish black chloride preserve their altered condition. Bromhydric and chlorhydric acids cannot indeed pass to the state of bromine or chlorine under the influence of the atmospheric oxygen.

Sulphurous acid which has undergone spontaneous modification behaves quite differently with iodate, bromate, and chlorate of silver. Thus, *in the most complete darkness*, it transforms iodate of silver suspended in pure water or in water acidulated with sulphuric acid into *orange* iodide, and the iodide, after having been washed with water and treated with cyanide of ammonium mixed with cyanhydric acid, dissolves with separation of flocks of sulphur, and even of sulphide of silver, if the modification of the sulphurous acid is much advanced. *In the most complete darkness*, bromide of silver suspended in pure water, or in water acidulated with sulphuric acid, instantly passes to the state of yellow bromide under the influence of the modified sulphurous acid, and the mother liquor becomes coloured dark yellow, brown, black, and after becoming decolourised by standing, contains a notable quantity of bromhydric acid. The insoluble precipitate, first washed with water, and then treated with cyanide of ammonium and cyanhydric acid, leaves much residue of sulphide of silver.

Lastly, *in the most perfect darkness*, chlorate of silver dissolved in pure water or in water acidulated with sulphuric acid is changed, under the influence of modified sulphurous acid, to the state of chloride mixed with much sulphide of silver, the supernatant liquid containing much hydrochloric acid.

Thus, *intact* sulphurous acid exerts upon iodate, bromate, and chlorate of silver a simple *reducing* action, whilst *modified* sulphurous acid exerts at the same time an action of *reduction* and of *sulphuration* similar to most of the polythionic acids.

ON THE SPECTRUM OF COMET II., 1868.*

By WILLIAM HUGGINS, F.R.S.

The author describes the appearance of the comet in the telescope on June 22 to consist of a nearly circular coma, which became rather suddenly brighter towards the centre, where there was a nearly round spot of light. A tail was traced for nearly a degree.

He found the light of the comet, when examined with a spectroscope, furnished with two prisms of 60°, to be resolved into three broad bright bands.

The brightest band commences at about *b*, and extends nearly to F. Another band begins at a distance beyond F, rather greater than half the interval between *b* and F. The third band occurs about midway between D and E. In the two more refrangible of these bands, the light was brightest at the less refrangible end, and gradually diminished towards the other limit of the bands. The least refrangible of the three bands did not exhibit a similar gradation of brightness.

These bands could not be resolved into lines, nor was any light seen beyond the bands toward the violet and the red.

The measures of these bands are given, and a diagram of their appearance.

The author found this cometic spectrum to agree exactly with a form of the spectrum of carbon which he had observed and measured in 1864. When an induction spark, with Leyden jars intercalated, is taken in a current of olefiant gas, the highly-heated vapour of carbon exhibits a spectrum which is somewhat modified from that which may be regarded as typical of carbon. The light is of the same refrangibilities, but the separate strong lines are not to be distinguished. The shading, composed of numerous fine lines, which accompanies the lines, appears as an unresolved nebulous light.

On June 23 the spectrum of the comet was compared directly in the spectroscope with the spectrum of the induction spark taken in a current of olefiant gas.

The three bands of the comet appeared to coincide with the corresponding bands of the spectrum of carbon. In addition to an apparent identity of position, the bands in the two spectra were very similar in their general characters and in their relative brightness.

These observations were confirmed on June 25.

The remarkably close resemblance of the spectrum of the comet with that of the spectrum of carbon necessarily suggests the identity of the substances by which in both cases the light was emitted.

The great fixity of carbon seems, indeed, to raise some difficulty in the way of accepting the apparently obvious inference from these prismatic observations. Some comets have approached sufficiently near the sun to acquire a temperature high enough to convert even carbon into vapour.

In the case of other comets, the author suggests that the difficulty is one of degree only, for the conditions are not known under which even a gas permanent at the temperature of the earth could maintain sufficient heat to emit light.

The author states that some phosphorescent substances give spectra which are discontinuous, but he gives reasons which would scarcely permit us to consider cometary light to be of a phosphorescent character.

The spectrum shows that the colour of this comet was bluish green. Considerable difference of colour has been remarked in the parts of some comets. Sir William Herschel described the head of the comet of 1811 to be of a greenish or bluish-green colour, while the central point appeared of a ruddy tint. The same colours have been observed in other comets. If carbon be the substance of some comets, this substance, if incandescent in the solid state, or reflecting, when in a condition of minute division, the light of the sun, would afford a light which, in comparison with that emitted by the luminous vapour of carbon, would appear yellowish or approaching to red.

The author refers to the bearing of these results on certain cometary phenomena, and on the apparent identity of the orbits of the periodical meteors with those of some comets.

LIQUID GLUE.

By M. KNAFFL.

This useful article, which is employed for a variety of purposes, as mending porcelain, glass, mother-of-pearl, &c., is not nearly so good when prepared with vinegar and nitric acid as that obtained by the following process:—Three parts of glue broken into small pieces should be covered with eight parts of water, and left to stand for some hours; one-half of chlorhydric acid and three-fourths of sulphide of zinc must then be added, and the whole exposed to a temperature of from 81° to 89° C. during ten or twelve hours. The compound thus obtained does not gelatinise; it only needs to be allowed to settle, and will be found a most useful agent for joining purposes.—(*Wochenschrift des Nieder-österreschichen Gewerbe-vereins*).

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* Abstract of a paper communicated to the Royal Society, July 2, 1868.

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Norwich Meeting, Wednesday August 19, 1868.

INAUGURAL ADDRESS OF THE PRESIDENT,

Joseph Dalton Hooker, Esq., F.R.S., D.C.L.,
Director of the Royal Gardens, Kew.

My Lords, Ladies, and Gentlemen,

Thirty years will to-morrow have elapsed since I first attended a meeting of the British Association; it was the one which opened at Newcastle on the 20th of August, 1838. On that occasion the Council of the Association resolved to recommend to Her Majesty's Government the despatch of an expedition to the Antarctic regions, under the command of Captain James Rep; and it was from Newcastle that I wrote to my friends announcing my resolve to accompany it in whatever capacity I could obtain a situation amongst its officers. It was thus that my scientific career was first shaped; and it is to this expedition, which was one of the very earliest results of the labours of the British Association, that I am indebted for the honour you have conferred upon me, in placing me in your President's chair.

If I now look back with pride to those immediately following years, when I had a share, however small, in the discovery of the Antarctic Continent, the Southern Magnetic Poles, the Polar Barrier, and the Ice-clad Volcanoes of Niteric Land, I do so also with other and far different feelings. Thirty years, as statisticians tell us, represent the average duration of a human life; I need not say, that as measured by the records of this British Association, a human lifetime is far shorter than this; for of the fourteen officers who presided over us in 1838 but two remain—your former President and devoted adherent for thirty-five years, Sir Roderick Murchison, who delivered the opening address on that occasion, and whose health, I regret to add, prevents his attendance at this meeting; and your faithful and ever-green Secretary, Professor Phillips, upon whose presence here I congratulate both you and him.

Again, looking back beyond thirty years ago, in the pages of your records I find those to have been halcyon years for Presidents when the preparation and delivery of the addresses devolved upon the Treasurer, Secretary, or other officers than the President; and that in fact presidential addresses date from the first meeting after that at Newcastle. Of late years these addresses have been regarded, if not as the whole duty of the President, certainly as his highest; for your sakes, as well as for my own, I wish this were not so, both because there are amongst your officers so many men far more competent than I am, and because I believe that the responsibility which the preparation of these addresses entails, limits disadvantageously your choice of Presidents. The impression is very prevalent that the address should either be a scientific *tour de force*, philosophical and popular, or a *resumé* of the progress of one or more important branches of science; and this view of the duty has greatly embarrassed me, inasmuch as I am unable to fulfil either of these requirements. On various occasions during the last half-year I have essayed to fulfil the wishes of my botanical friends, that I should either discuss the phenomena of the vegetable kingdom in their relation to collateral sciences, or sketch the rise and progress of Scientific Botany during the present century, or a portion of it; but every such essay has been quickly frustrated by the pressure of official duties. Such themes require much research, much thought, and, above all, some continuous leisure, during which the whole mind may be concentrated on the method of treatment, as well as upon the material to be treated of; and this leisure was incompatible with the discharge of my duties as administrator of a large public department, entailing a ceaseless correspondence with the Government offices and with botanical establishments all over the globe. And I do not ask your indulgence for myself alone, for there are at this meeting official men of scientific attainments, who have accepted the presidentships of sections, but who, on leaving their posts to do your bidding, drag a lengthening chain of correspondence after them, and sacrifice no short portion of those brief holidays which are allowed to public officers. After all, it is deeds, not words, that we want from them; and I am proud to find our sections presided over by men who have won their spurs in their respective sciences, and who will wear them in the chairs they occupy, and use them too, if needs must.

For my own part I propose to offer you some remarks upon several matters to which the attention of your Council was directed when at Dundee—and then upon some of the great advances that have been made in Botany during the last few years—this will infallibly drag me into Darwinism: after which I shall allude to some matters connected with that dawning science, the Early History of Mankind, a theme which will be a distinguishing collateral feature of the Norwich Association. If in all this I disappoint you, it will be my solace to hope that I may thereby break the fall of some future President, who, like myself, may have all the will, but not the time, adequately to meet your great expectations.

Before commencing, however, I must attend to a circumstance which cannot but be uppermost in the minds of all habitual attendants at these annual gatherings—it is, that but for a severe accident, there would have been present here to-night the oldest surviving, and indeed the first but two of the Presidents of the British Association; my geological friends will understand to whom I allude, as that Rock of Science in whom age and the heat and shocks of scientific controversy have wrought no metamorphosis, and developed no cleavage planes—a man of whom both Norwich and the Association are proud—your Canon, our father, Sedgwick.

My first duty as President is the pleasant one of introducing to you the members of the International Congress of Pre-historic Archæology, who under the presidency of Sir John Lubbock, himself a master of this branch of knowledge, open their third session to-morrow in this city. The researches which specially occupy the attention of the Congress, are perhaps the most fascinating that ever engaged the faculties of man; and pursued as they now are in a scientific spirit, and in due subjection to scientific methods, they will command all the sympathy, and their meetings will receive all the support that my fellow members of the British Association can afford to them. And there is one way in particular by which we can show our goodwill and give our support,—and it is so simple that I hope no one will neglect it,—and that is, that we shall all call at their official residence at the Free Library, inscribe our names in their books, and obtain cards for their meetings.

The next subject which I have to bring officially before you will interest the members of the Congress no less than ourselves, and relates to the action of a committee which your Council appointed, to represent to the Secretary of State for India "the great and urgent importance of adopting active measures to obtain reports on the physical form, manners, and customs of the indigenous populations of India, and especially of those tribes which are still in the habit of erecting Megalithic monuments."

Upon consideration, the committee decided that it would be better in the first instance, to direct the attention of the Secretary of State to the last-mentioned tribes only, both because the whole enquiry was so vast, and because systematic efforts are now being made by the Indian Government to obtain photographs and histories of the native Indian tribes. Their efforts are, as regards the photographs obtained in India, eminently successful, which renders it all the more disappointing that the descriptive matter appended to them in this country, and which is happily anonymous, is most discreditable to the authority under which it is issued.

It will, no doubt, surprise many here to be told that there exists, within 300 miles of the British capital of India, a tribe of semi-savages who habitually erect dolmens, menares, cysts, and cromlechs, almost as gigantic in their proportions, and very similar in appearance and construction, to the so-called Druidical remains of Western Europe; and what is still more curious, though described and figured nearly a quarter of a century ago by Col. Yule, the eminent oriental geographer, except by Sir John Lubbock, they are scarcely alluded to in the modern literature of prehistoric monuments. In the *Bengal Asiatic Journal* for 1844, you will find Col. Yule's description of the Khasia people of East Bengal, an Indo-Chinese race, who keep cattle but drink no milk, estimate distances traversed by the mouthfuls of *pawn* chewed *en route*, and amongst whom the marriage tie is so loose, that the son commonly forgets his father, when the sister's son inherits property and rank. Dr. Thomson and I dwelt for some months amongst the Khasia people, now eighteen years ago, and found Col. Yule's account to be correct in all particulars. The undulatory eminences of the country, some 4,000 to 6,000 feet above the level of the sea, are dotted with groups of huge unpolished squared pillars, and tabular slabs, supported on three or four rude piers.

In one spot, buried in a sand grove, we found a nearly complete circle of menhies, the tallest of which was 30 feet out of the ground, 6 feet broad, and 2 feet 8 inches thick; and in front of each was a dolmen or cromlech of proportionately gigantic pieces of rock, whilst the largest slab hitherto measured is 32 feet high, 15 feet broad, and 2 feet thick.

Several that we saw had been very recently erected, and we were informed that every year some are put up, but not in the rainy season, which we spent in the country. The method of removing the blocks is by cutting grooves, along which fires are lit, and into which, when heated, cold water is run, which causes the rock to fissure along the groove; the lever and rope are the only mechanical aids used in transporting and erecting the blocks. The objects of their erection are various—sepulture, marking spots where public events had occurred, &c. It is a curious fact that the Khasian word for a stone, "Man," as commonly occurs in the names of their villages and places, as that of Man, Maen, and Men, does in those of Brittany, Wales, Cornwall, &c.; thus Mansmai signifies in Khasia the Stone of Oath—Mamloo, the Stone of Salt—Manflong, the Grassy Stone; and, just as in Wales, Per mæn maur signifies the Hill of the Big Stone; and in Brittany a Macuhyr is a Standing Stone, and a Dolmen a Table Stone, &c.

At the date of Colonel Yule's, as of my visit to these people, our intercourse with them was limited, and not always friendly; we were ignorant of their language, and they themselves far from communicative. Of late, however, the country has been more opened up, and the establishment of a British cantonment amongst them renders it all the more important that the inquiry into their origin language, beliefs, customs, &c., should be followed up without delay. This will now be done, thanks to your representations, and I cannot doubt but that it will throw great light upon that obscure and important branch of Prehistoric Archæology, the Megalithian monuments of Western Europe.

The Council of the Association, upon the recommendation of the Biological Section, appointed a committee to report upon the subject of the government of the Natural History collections of the British Museum, which resulted in a deputation, who represented to the Prime Minister, in the name of the Council:—that it was desirable that these collections be placed under the control of a single officer, who should be directly responsible to a Minister of the Crown; and that this opinion was shared by an overwhelming majority of British naturalists. The reasons stated were, that there appeared no reason why the national collections of Natural History should be administered in a way different from that which was found applicable to the Royal Gardens and Botanical collections at Kew, the Museum of Practical Geology, and the Royal Observatory at Greenwich,—and that the interposition of any board or committee between the superintendent of the collections and the Government must interfere with the responsibility of the superintendent and the efficient control of the Minister.

It was not for the first time that this subject had been brought before Her Majesty's Government, and indeed before the self-same Prime Minister; for, ten years previously a few naturalists, consisting of Messrs. Bentham, Bush, Darwin, Huxley, Dr. Carpenter, and myself, together with the late Professors Lindley, Henslow, Harvey, and Henfrey, presented a memorial to Mr. Disraeli, then, as now, Prime Minister, embodying precisely the same views as to the government of the Natural History Department of the British Museum, together with a scheme for the administration of the whole Metropolitan Natural History collection, Geological and Botanical; and I have only to add, regarding this document, that the surviving memorialists have not, during the ten intervening years, found reason to alter the views therein expressed on any vital point.

Of the objections to the present system of government by trustees, some of the most grave have been stated by Mr. Andrew Murray in a communication* made to the Biological Section at Dundee; to which I would only add, that though the Zoological collections are the finest in the world, and the Geological and Palæontological of prodigious extent and value, there are of the forty-five trustees, only three who have any special knowledge whatsoever of the branches of science these collections illustrate; that since Sir Joseph Banks' death, nearly half a century ago, no botanist has ever been appointed a trustee, though the Banksian Herbarium and Botanical Library, then amongst the most valuable in Europe, were left by their owner to the nation, and, in fine, that the interests of Botany have by their trustees been greatly neglected.

Much as has been written upon the uses of museums, I believe that the subject is still far from being exhausted, for, in the present state of education in this country, these appear to me to afford the only means of efficiently teaching to schools the elements of Zoology and Physiology. I say in the present state of education, because I believe it will be many years before we have schoolmasters and schoolmistresses trained to teach these subjects; and many more years before either provincial or private schools will be supplied with such illustrative specimens as are essential for the teacher's purposes.

Confining myself to the consideration of provincial and local museums, and their requirements for educational purposes, each should contain a series of specimens illustrating the principal and some of the lesser divisions of the animal and vegetable kingdoms, so disposed in well lighted cases as that an inquiring observer might learn therefrom the principles upon which animals and plants are classified, the relations of their organs to one another and to those of their allies, the functions of those organs; and other matters relating to their habits, uses, and place in the economy of nature. Such an arrangement has not been carried out in any museum known to me, though partially attained in that at Ipswich; it requires some space, many pictorial illustrations, magnified views of the smaller organs and their structure, and copious legible descriptive labels, and it should not contain a single specimen more than is wanted. The other requirements of a provincial museum are, complete collections of the plants and animals of the province, which should be kept entirely apart from the instructional series, and from everything else.

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* Report for 1867. Transactions of Sections, p. 95.

The curator of the museum should be able to give elementary demonstrations (not lectures, and quite apart from any powers of lecturing that he may possess) upon this classified series, to schools and others, for which a fee should be charged and go to the support of the institution. And the museum might be available (under similar conditions of payment) for lectures and other demonstrations.

Excellent manuals of many branches of Geology are now published, which are invaluable to the advanced student and demonstrator; but from which the schoolboy recoils who would not refuse to accept objects and pictures as memory's pegs on which to hang ideas, facts, and hard names. To schoolboys, skeletons have often a strange fascination, and upon the structure of these and the classification of the vertebrata much depends. What boy that had ever been shown their skulls would call a seal or porpoise a fish, or believe a hedgehog could milk cows? as I am told many boys in Norfolk and Suffolk (as elsewhere) do believe implicitly.

A series of illustrated specimens, occupying some 5,800 feet of wall space, would give at a glance a connected and intelligible elementary view of the classification and structure of the whole animal kingdom; it would stand in the same relation to a complete museum and *systema naturæ*, as a chart on which the principal cities and coast-lines are clearly laid down, does to a map crowded with undistinguishable details.

Much of the utility of museums depend on two conditions often strangely overlooked, viz., their situation and their lighting and interior arrangements. The provincial museum is too often huddled away almost out of sight in a dark, crowded, and dirty thoroughfare, where it pays dear for ground-rents, rates, and taxes, and cannot be extended; the object, apparently, being to catch country people on market days. Such localities are frequented by the townspeople only when on business, and when they consequently have no time for sight-seeing. In the evening, or on holidays, when they could visit the museum, they naturally prefer the outskirts of the town to its centre.

Hence, too, the country gentry scarcely know of the museum's existence; and I never remember to have heard of a provincial museum that was frequented by schools, but rather the contrary. I do not believe that this arises from indifference to knowledge on the part of the upper classes or of teachers, but to the generally uninstructive nature of the contents of these museums, and their uninviting exterior and interior.

There are plenty of visitors of all classes to the museums at Kew, despite the outer attractions of the gardens, and I know no more pleasing sight than these present on a Sunday and Monday afternoon, when crowded by intelligent visitors, directing their children's attention to the ticketed objects in the cases.

The museum should be in an open grassed square or park, planted with trees, in, or in the outskirts of, the town, a main object being to secure cleanliness, a cheerful aspect, and space for extension. Now, vegetation is the best intercepter of dust, which is injurious to the specimen as well as unsightly, whilst a cheerful aspect and grass and trees will attract visitors, and especially families and schools.

If the external accessories of provincial museums are bad, the internal are often worse; the rooms are usually lighted by windows on one side only, so that the cases between the walls are dark, and those opposite the window reflect the light when viewed obliquely, and when viewed in front the visitor stands in his own light. For provincial museums, when space is an object, there is no better plan than rectangular long rooms, with opposite windows on each side, and buttress cases projecting into the room between each pair of windows. This arrangement combines economy of space with perfect illumination, and affords facilities for classification.

In respect of its Natural History collections the position of the British Museum appears to me to be a disadvantageous one; it is surrounded by miles of streets, including some of the principal Metropolitan thoroughfares, which pour clouds of dust and the product of coal combustion into its area day and night; and I know few more disappointing sights to me than its badly-lighted interior presents on a hot and crowded public holiday, when whole families from London and its outskirts flock to the building. Then young and old may be seen gasping for fresh air in its galleries, with no alternative but the hotter and dustier streets to resort to. How different it would be were these collections removed to the townward end of one of the great parks? where spacious and well-lighted galleries could be built, amongst trees, grass, and fountains; and where whole families need not any more be cooped up for the day in the building, but avail themselves of the fresh air and its accessories at the same time as they profit by the collection.

My remarks on the British Museum convey no rereflection on the able officers who have, in so short a time, formed this wonderful collection. The late Mr. Lawrence, in his lecture in 1815, congratulates his audience on the formation of a zoological collection having been just determined upon;—in 1838, when I first knew the Museum in Old Montague House, I was told it ranked about the sixth in Europe—now, and for some years past, it has been considered to be the finest in the world. This is due to the energy and ability of the keepers and curators, and, in mentioning them, I would wish to pay a passing tribute to the merits of the venerable Dr. Gray, who has devoted his life to the development of the Zoological department with a singleness of purpose, liberality, and zeal that are beyond all praise.

At the time when Old Montague House contained the National Collections, there was but one museum in the Metropolis in which the naturalist could study to much purpose; this was the Hunterian (of the Royal College of Surgeons), then under the superintendence of the late Mr. Clift and of Professor Owen, the friend of my early youth when preparing myself to accompany the Antarctic Expedition, and who instructed me in the use of that now unrivalled series of catalogues that owed so much to himself. From the Museum of the Royal College of Surgeons, the national and provincial museums of England have much to learn, and to copy, and thanks to the wisdom and munificence of the council of the college, and to the zeal and ability of the present conservator, Mr. Flower, it retains the position it attained thirty years ago, of being the best and richest institution of the kind in Europe.

In my own special science the greatest advances that have been made during the last ten years have been in the departments of Fossil Botany, and Vegetable Physiology.

In the past history of the globe, two epochs stand prominently out—the carboniferous and the miocene—for the abundant material they afford, and the light they consequently throw on the early conditions of the vegetable kingdom. Why plants should have been so much more lavishly preserved during these than during some of the intervening or earlier epochs we do not rightly know; but the comparative poverty of the floras of these latter is one amongst the strongest evidences of the imperfection of the Geological record.

Our knowledge of coal plants, which, since the days of Sternberg, Brongnart, and Lindley and Hutton, has been chiefly advanced by Gœppert and Unger on the Continent, and by Dawson in Canada, has received very important accessions of late through the untiring energy of Mr. Binney, of Manchester, who has devoted nearly thirty years to the search for those rarely found specimens which exhibit the internal structure of the plant. His elaborate descriptions of the most abundant, and, till his researches, the least understood plant of the coal measures, *Calamites*, has just appeared in the memoirs of the Palæontographical Society; and some of Mr. Binney's materials having also formed the subject of a very recent and valuable paper by Mr. Carruthers, of the British Museum, I may quote their joint results as one. These show that Calamites is an actual member of the existing family of Equisetaceæ, which contained previously but one genus, that of the common mare's tails of our river-banks and woods; as also, that nearly a dozen other genera of coal measures plants may be referred to it. This affinity of Calamites had, indeed, been guessed at before, and the genera now referred to it, having been founded on mere fragments, were always doubtful; but the value of these positive identifications is none the less on these accounts. It may hereafter prove of some significance that these Calamites, which, in the coal epoch, assumed gigantic proportions, and presented multitudinous forms and very varied organs of growth, are now represented by but one genus, differing most remarkably from its prototype in size and the simplicity and uniformity of its vegetable organs.

Passing to the tertiary times, the labours of Count Saperta in France, of Gaudin and Strozzi, and of Massolongli in Italy, of Lesquereux]in America, and above all of Heer in Switzerland, have within the last ten years accumulated in vast number of species of fossil plants, and if the determination of the affinities of the majority are dependable, they prove the persistence throughout the tertiary strata of many interesting families and genera, and the rarity of others than these. Here, however, much value cannot be attached to negative evidence. Almost the only available materials for determining the affinities of the vast majority of these tertiary plants are their mutilated leaves, and, unlike the bones of vertebrate animals, and the shells of molluscs, the leaves of individual plants are extremely variable in all their characters. Furthermore, the leaves of plants of different natural families, and of different countries, mimic one another to such a degree, that in the case of recent flowers, every botanist regards these organs as most treacherous guides to affinity. Of the structural characters which are drawn from the internal organs of plants, and especially from their fruit, seeds, and flowers, few traces are to be found in the fossils, and yet it is from them exclusively that the position of a recent plant in the vegetable kingdom can be certified. An instructive instance of over-reliance on leaves, and perhaps, too, on unperceived ideas, happened not long ago to a palæontologist of such distinguished merit that his reputation cannot suffer from an allusion to it. In the course of his labours over some imperfect specimen from a most interesting locality, he referred these associated impressions of fossil leaves to three genera, belonging to as many different families of plants, and was thus helped to what would have been some important conclusions as to the vegetation of the period in which they were deposited. A subsequent observer, who was a botanist but not a palæontologist, declares these three supposed genera to be the three leaflets of one leaf of one plant, and this the common blackberry, which still grows on the spot. Which of the two is right, I do not say; the fact shows to what opposite conclusions different observers of the same fossil materials may be led.

In this most unreliable of sciences—Fossil Botany—we do but grope in the dark; of the thousands of objects we stumble against, we here and there recognise a likeness to what we have elsewhere known, and rely on external similitude for a helping hand to its affinities; of the great majority of specimens we know nothing for certain, and of no small proportion we are utterly ignorant.

If, however, much is uncertain, all is not so, and the science has of late made sure and steady progress, and developed really grand results. Heer's labours on the miocene and pliocene floras especially are of the highest value and interest; his conclusions regarding the flower of the Bovey Tracy coal beds (for the publication of which, in a form worthy of their value and of their author's merit, we are indebted to the wise liberality of Miss Burdett Coutts) are founded on a sufficient number of absolute determinations; and his more recent *Flora Fossilis Arctica*, threatens to create a revolution in Tertiary Geology. In this latter work, Professor Heer shows, on apparently unassailable evidence, that forests of Austrian, American, and Asiatic trees flourished during miocene times in Iceland, Arctic Greenland, Spitzbergen, and the Polar American Islands, in latitudes where such trees could not now exist under any conceivable conditions or positions of land, or sea, or ice, and leaving little doubt but that an arboreous vegetation once extended to the Pole itself. Discoveries such as these appear at first actually to retard the progress of science, by confounding all previous geological reasoning as to the climate and condition of the globe during the tertiary epoch.

I have said that the greatest botanical discoveries made during the last ten years have been physiological, and I here alluded especially to the series of papers on the "Fertilisation of Plants," which we owe to Mr. Darwin. You are aware that this distinguished naturalist, after accumulating stores of facts in Geology and Zoology during his circumnavigation of the globe with Captain Fitzroy, espoused the doctrine of the continuous evolution of life, and by applying to it the principles of natural selection, evolved his theory of the origin of species. Instead of publishing these views as soon as conceived, he devoted twenty more years to further observation, study, and experiment, with the view of maturing or subverting them. Amongst the subjects requiring elucidation or verification were many that appertained to Botany, but which had been overlooked or misunderstood by botanical writers, and these he set himself to examine vigorously.

The first fruits of his labours was his volume on the "Fertilisation of Orchids," undertaken to show that the same plant is never continuously fertilised by its own pollen, and that there are special provisions to favour the crossing of individuals. As his study of the British species advanced, he became so interested in the number, variety, and complexity of the contrivances he met with that he extended his survey to the whole family, and the result is a work of which it is not too much to say that it has thrown more light upon the structure and functions of the floral organs of this immense and anomalous family of plants than had been shed by the labours of all previous botanical writers. It has, further, opened up entirely new fields of research, and discovered new and important principles that apply to the whole vegetable kingdom.

This was followed by his paper on the two well-known forms of the primrose and cowslip,* popularly known as the pin-eyed and the thrum-eyed; these forms he showed to be sexual and complementary; their diverse functions being to secure, by their mutual action, full fertilisation, which he proved could only take place through insect agency. In this paper he established the existence of homomorphic, or legitimate and heteromorphic, or illegitimate unions amongst plants, and details some curious observations in the structure of the pollen. The results of this, perhaps more than any other of Mr. Darwin's papers, took botanists by surprise; the plants being so familiar, their two forms of flower so well known to every intelligent observer, and his explanation so simple. In myself I felt that my botanical knowledge of these homely plants had been but little deeper than Peter Bell's, to whom

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* Journal of the Linnean Society, vol. vii., p. 77.

> A primrose by the river's brim
> A yellow primrose was to him,
> And,—it was nothing more.

Analogous observations on the dimorphism of flax-flowers and their allies,[*] formed the subsequent paper, during which he made the wonderful discovery that the common flax, the pollen of one form of flower, is absolutely impotent when applied to its own stigma, but invariably potent when applied to the stigma of the other form of flower; and yet both pollens and stigmas of the two kinds are utterly undistinguishable under the highest powers of the microscope.

His third investigation is a very long and laborious one on the common loose-strife,[†] (Lythrum salicaria), which he showed to be trimorphic, this one species having three kinds of flowers, all annually abundantly produced, and as different as if they belonged to different species; each flower has, further, three kinds of stamens, differing in form and function. We have in this plant, then, six kinds of pollen, of which five at least are essential to complete fertility, and three distinct forms of style. To prove these various differences, and that the co-adaptation of all these stamens and pistils was essential to complete fertility, Mr. Darwin had to institute eighteen sets of observations, each consisting of twelve experiments, 216 in all. Of the labour, care, and delicacy required to guard such experiments against the possibility of error, those alone can tell who know experimentally how difficult it is to hybridise a large flowered plant of simple form and structure. The results in this case, and in those of a number of allied plants experimented on at the same time, is what the author's sagacity predicted; the *rationale* of the whole was demonstrated, and he finally showed, not only how nature might operate in bringing these complicated modifications into harmonious operation, but how through insect agency she does do this, and why she does it too.

It is impossible even to enumerate here the many important generalisations that have flowed from these and other papers of Mr. Darwin's on the fertilisation of plants; some that appear to be common-place at first sight are really the most subtle, and, like many other apparent common-places, are what, somehow, never occur to common-place minds: as, for instance, that all plants with conspicuously coloured flowers, or powerful odours, or honeyed secretions, are fertilised by insects; all with inconspicuous flowers, and especially such as have pendulous anthers, or incoherent pollen, are fertilised by the wind; from whence he infers that, before honey-feeding insects existed, the vegetation of our globe could not have been ornamented with bright-coloured flowers, but consisted of such plants as pines, oaks, grasses, nettles, &c.

The only other botanical paper of Mr. Darwin's to which I can especially allude, is that "On the Habits and Movements of Climbing Plants,"[‡] which is a most elaborate investigation into the structure, modification, and functions of the various organs by which plants climb, twine, and attract themselves to foreign objects. In this he reviews every family in the vegetable kingdom, and every organ used by any plant for the above purpose. The result places the whole subject in a totally new light before us. The guesses, crude observations, and abortive experiments that had disfigured the writings of previous observers are swept away; organs, structures, and functions of which botanists had no previous knowledge are revealed to them, and the whole investigation is made as clear as it is interesting and instructive.

The value of these discoveries, which add whole chapters to the principles of Botany, is not theoretical only: already the horticulturalist and agriculturalist have begun to ponder over them, and to recognise in the failure of certain crops the operation of laws that Mr. Darwin first laid down. What Faraday's discoveries are to telegraphy Mr. Darwin's will assuredly prove to rural economy, in its widest sense and most extended application.

Another instance of successful experiment in Physiological Botany is Mr. Herbert Spencer's observations on the circulation of the sap and formation of wood in plants.[*] As is well known, the tissues of our herbs, shrubs, and trees, from the tips of their roots to those of their petals and pistils, are permeated by tubular vessels. The functions of these have been hotly disputed, some physiologists affirming that they convey air, others fluids, others gases, and still others assigning to them far-fetched uses of a wholly different nature. By a series of admirably contrived and conducted experiments, Mr. Spencer has not only shown that these vessels are charged at certain seasons of the year with fluid, but that they are intimately connected with the formation of wood. He further investigates the nature of the special tissues concerned in this operation, and shows not merely how they may act, but to a great extent how they do act. As this paper will, I believe, be especially alluded to by the President of the Biological Section, I need dwell no further on it here than to quote it as an example of what may be done by an acute observer and experimentalist, versed in Physics and Chemistry, but above all thoroughly instructed in scientific methods.

Mr. Darwin's recent two volumes "On Animals and Plants under Domestication," is a catacomb of data, observations, and experiments such as assuredly no one but himself could produce. It is hard to say whether it is most remarkable for the number and value of the new facts it discloses, or for its array of small forgotten or overlooked observations, neglected by some naturalists and discarded by others which, under his mind and eye, prove to be of first-rate scientific importance. An eminent surgeon and physiologist (Mr. James Paget) has remarked to me, *apropos* of these volumes, that they exemplify in a most remarkable manner that power of utilising the waste materials of other scientific men's laboratories, which is a very characteristic feature of their author. As one of those pieces justificative of his previous work, "The Origin of Species," which have been waited for so long and impatiently, these volumes will probably have more than their due influence, for the serried ranks of facts in support of his theories which they present may well awe many a timid naturalist into bolting more obnoxious doctrines than that of natural selection.

It is in this work that Mr. Darwin expounds his new hypothesis of pangenesis, which certainly correlates, and may prove to contain the *rationale* of all the phenomena of reproduction and of inheritance. You are aware that every plant or animal commences its more or less independent life as a single cell, from which is developed an organism more or less closely similar to its parents. One of the most striking examples I can think of is afforded by a species of Begonia, the stalks, leaves, and other parts of which are superficially studded with loosely attached cells. Any one of those cells, if referred to favourable conditions, will produce a perfect plant, similar to its parent. You may say that these cells have inherited the potentiality to do so, but this is not all, for every plant thus produced in like manner, develops on its stalks leaves and myriads of similar cells, endowed with the same property of becoming such in new plants; and so on, apparently interminably. Therefore the original cell that left the grandparent, not only carried with it this so-called potentiality, but multiplied it and distributed it with undiminished power through the other cells of the plant itself produced; and so on, for countless generations. What is this potentiality, and how is this power to reproduce thus propagated, so that an organism can, by single cells, multiply itself so rapidly, and within very narrow limits, so surely and so interminably? Mr. Darwin suggests an explanation, by assuming that each cell or fragment of a plant (or animal) contains myriads of atoms or geminules, each of which geminule he supposes to have been thrown off from the separate cells of the mother-plant, the geminules having the power of multiplication, and of circulating throughout the plant; their future development, he supposes to depend on their affinity for other partially developed cells in due order of succession. Geminules which do not become developed may, according to his hypothesis, be transmitted through many succeeding generations, thus enabling us to understand many remarkable cases of reversion or atavism. Thus, according to this hypothesis, not only have the normal organs of the body, the representative elements of which they consist, diffused through all the other parts of the body, but the morbid states of these, as hereditary diseases, malformations, &c., all actually circulate in the body as morbid geminules.

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[*] Journal of the Linnean Society, vol. vii., p. 69.

[†] Ibid., vol. viii., p. 169.

[‡] Ibid., vol. ix., p. 1.

[*] "Linnean Transactions," vol. xxv., p. 405.

As with other hypotheses based on the assumed existence of structures and elements that escape our senses by reason of their minuteness or subtlety, this of pangenesis will approve itself to some minds and not to others. To some these inconceivably minute circulating geminules will be as apparent to the mind's eye as the stars of which the milky way is composed; others will prefer embodying the idea in such a term as potentiality, a term which conveys no definite impression whatever, and they will like it none the less on this account.

Whatever be the scientific value of these geminules, there is no question but that to Mr. Darwin's enunciation of the doctrine of pangenesis we owe it, that we have the clearest and most systematic *resumé* of the many wonderful phenomenon of reproduction and inheritance that has yet appeared; and against the guarded entertainment of the hypothesis, on speculation if you will, as a means of correlating these phenomena, nothing can be urged in the present state of science. The president of the Linnean Society, a proverbially cautious naturalist, thus well expresses his own ideas of pangenesis: "If," he says, "we take into consideration, *how* familiar mathematical signs and symbols make us with numbers and combinations, the actual realisation of which is beyond all human capacity, *how* inconceivably minute must be those emanations which most powerfully affect our sense of smell and our constitutions; and if, discarding all preventions, we follow Mr. Darwin, step by step, in applying his suppositions to the facts set before us, we must, I think, admit that they may explain some, and are incompatible with others; and it appears to me that pangenesis will be admitted by many as a provincial hypothesis, to be further tested, and to be discarded only when a more plausible one shall be brought forward."

(To be concluded.)

FOREIGN SCIENCE.

Paris, Aug. 19, 1868.

Another process of Refining Sugar.—Oxychloride of Carbon.—Amides of Sulphoxyphosphoric Acid. Academy of Sciences:—Magnetic Polarity of Artificially-prepared Iron Pyrites and Oxide.—Colouring Matter of Persian Berries.—Marshy Waters.

Another process of refining sugar has just been published. According to M. Monnier's experiments, when a current of anhydrous sulphurous acid is passed into a chamber containing coarse sugar, a bleaching action ensues, and three-fourths of the colouring matter of the sugar is destroyed, while no alteration whatever is suffered by the sugar itself. After this treatment, the sugar is strongly impregnated with sulphurous acid, but the presence of this body does not interfere with subsequent operations. About 4 parts of sulphur are required for every 1000 of sugar, but when the process is in regular operation, the amount of sulphur can be sensibly diminished. The sulphurous acid gas is obtained by burning sulphur in a small furnace adjoining the chamber. When the operation is terminated, the sugar is dissolved in water, and the sulphurous acid neutralised by lime previously converted into sucrate of lime. M. Monnier feared that, in practice, the anhydrous sulphurous acid might modify the sugar, and convert a portion into grape sugar. He has, however, convinced himself that no action of this kind takes place; the proportion of uncrystallisable sugar, found by analysis, after treatment by the process, being always exactly equal to the original amount. In all the experiments the sugar remained exposed to the bleaching action for forty-eight hours. This process gives excellent results with the strongly-coloured West Indian sugars; with samples less coloured the action is not so marked. In the first case, two-thirds or three-fourths of the colouring matter is completely removed.

M. Schützenberger has produced oxychloride of carbon by substituting Cl_2 by Θ, in tetrachloride of carbon, CCl_4. The formation of this substance was effected in three different ways. When chloride of carbon and dry oxide of zinc were heated together in a close vessel to 200°, for several hours, upon opening the tube, a large quantity of gas containing oxychloride of carbon escaped. A considerable quantity of carbonic acid is also formed by this treatment; the first reaction is—

$$CCl_4 + Zn\Theta = CCl_2O + Cl_2Zn,$$

followed by the secondary reaction,—

$$COCl_2 + Zn\Theta = C\Theta_2 + Cl_2Zn.$$

Another mode of formation is by passing over pumice stone, heated to 350°, a mixture of carbonic oxide and the vapour of tetrachloride of carbon. In this case—

$$2(CCl_4) + C\Theta = C\Theta Cl_2 + C_2Cl_4.$$

Thirdly, the carbonic oxide in this reaction may be replaced by carbonic acid with perfect success, the reaction being—

$$CCl_4 + C\Theta_2 = 2(C\Theta Cl_2).$$

The following is an abstract of a note on the amides of sulphoxyphosphoric acid communicated to the Academy by M. Chevrier, in April. According to M. Baudrimont's experiments, published in 1861, chlorosulphide of phosphorus absorbs ammonia gas, at the same time becoming heated and solid; 6 grammes of $PSCl_3$* take up 1·8 grammes of this gas, corresponding to three equivalents. The product formed is slightly yellow; heated, it evolves chloride and sulphide of ammonium, leaving an insoluble residue attacked by nitric acid with difficulty. Before calcination, the product was entirely soluble in water. M. Chevrier's experiments lead to a somewhat different result: 6 grammes of $PSCl_3$ absorb, not 1·8 grammes of ammonia gas, but 3·6 grammes, or six equivalents. Two different products are formed in this reaction—chloride of ammonium, and an amorphous solid body of a yellowish white colour. This body is insoluble in water, difficultly soluble in alcohol, ether, and sulphide of carbon: Heated in a test-tube it evolves sulphide of ammonium; heated with potash, it evolves ammonia. Fuming nitric acid attacks it with considerable energy, producing sulphuric acid and phosphoric acid. Analysis led to the formula PSN_3H_6; comparing this with the ammonia type, we have—

$$\left.\begin{matrix} H_3 \\ H_3 \\ H_3 \end{matrix}\right\} N_3 \text{ and } \left.\begin{matrix} (PS)''' \\ H_3 \\ H_3 \end{matrix}\right\} N_3$$

When chlorosulphide of phosphorus is added, in small portions, to liquid ammonia in large excess, a lively reaction is produced. The temperature rises rapidly, and by agitating the mixture the chlorosulphide is soon entirely absorbed. Sulphoxyphosphate of ammonia, corresponding to M. Wurtz's soda salt, and chloride of ammonium are thus obtained. This salt is as little stable as sulphoxyphosphoric acid itself. Its solution cannot be concentrated, neither by heat, nor in vacuo. The reaction of chlorosulphide of phosphorus upon aniline is also very energetic, one equivalent of the chlorosulphide and six of aniline take part in it. The temperature increases considerably, but no gas is disengaged. Neither the odour of chlorosulphide of phosphorus nor that of aniline is perceived in the product. By washing with water, the hydrochlorate of aniline is easily removed, and a yellow solid matter remains, containing sulphur, phosphorus, carbon, hydrogen, and nitrogen. Analysis leads to the formula, $PSC_{18}H_{15}N_3$, or

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* $P = 31$, $S = 32$, $Cl = 35·5$.

$$\left.\begin{array}{r}(PS)'''\\(C_6H_5)_3\\H_3\end{array}\right\}N_3$$

This represents phenylsulphotriphosphamide. It is a hard yellow substance, brittle and friable. The amide is soluble in alcohol; it melts at 78°, and commences to decompose about 200°, disengaging aniline.

At the *séance* of the Academy, held on the 20th July, M. Sidot communicated his researches "On the Magnetic Polarity of Artificially-Prepared Iron Pyrites, and the Corresponding Oxide;" "The Colouring Matter of Persian Berries" was the subject of a communication by M. Schützenberger; and M. Dehérain contributed a note "On Marshy Waters."

On a former occasion, M. Sidot showed several samples of iron pyrites possessing magnetic polarity, obtained by passing a current of hydrosulphuric acid over the magnetic oxide. At that time he stated that the direction of the polar axis appeared to be in relation to the position of matters at the moment of their formation with reference to the magnetic axis of the globe. M. Sidot has now tested his supposition further by examining the behaviour of the oxide of iron, Fe_3O_4, examining whether it suffered the same physical modifications, being placed in the same conditions, as magnetic pyrites, and whether the polarity was produced by the earth by removing all causes foreign to terrestrial action. When a tube of refractory clay is placed parallel to the magnetic needle, in a furnace free from iron, and in the tube a platinum boat filled with colcothar, which is heated to bright redness in a current of air for an hour, the result, after cooling, is a strongly agglomerated grey oxide, possessed of magnetic polarity. The extremity of the oxide turned towards the north is a south pole; it energetically repulses the pole of a magnetic needle pointing to the north of the earth. Magnetic oxide is likewise obtained by calcining colcothar in a platinum crucible. The upper extremity of the mass presents a pole opposed to the south pole of the globe, and the lower extremity an opposite pole. To obtain masses possessed of greater magnetic polarity a different disposition was made. A piece of iron plate, in the form of a tube, was suspended in a clay tube, placed vertically in a furnace traversed by a very rapid current of air, and heated to bright redness for the time necessary for the complete oxidation of the iron. Tubes of oxide were thus obtained possessed of magnetic polarity, and strongly repulsing the poles of the magnetic needle. The polarity is always dependent upon the position of the iron plate. The magnet produced in this way was replaced in the furnace, reversed, and heated in the same conditions of temperature as before for one hour; after cooling, the poles were found to be reversed; that pole which is formed at the upper extremity is always similar to the north pole of the earth.

Persian berries contain colouring principles soluble in water, and capable of transformation, in certain circumstances, and notably by ebullition with sulphuric acid, into yellow pigments, sparingly soluble or insoluble (xanthorhamnine of Gellaty, rhamnegine of Lefort). Gellaty had stated this transformation to be a consequence of the decomposition of a glucoside; in a more recent work M. Lefort affirmed, on the contrary, that soluble rhamnegine, in becoming changed into rhamnine (rhamnetine of Gellaty), only suffered molecular modification, and that no sugar was formed. Also M. Bolley has considered rhamnetine as identical with quercetine from quercitron. M. Schützenberger finds, according to the indications of Gellaty, and contrary to the assertions of M. Lefort, that rhamnegine (rhamnine of Gellaty) gives a colourless saccharine matter upon ebullition with very dilute sulphuric acid. Operating with a solution of pure crystallised rhamnegine, 100 parts of colouring matter gave—sugar, 65, insoluble colouring matter, 42. The sugar from rhamnegine is uncrystallisable, of very decided sweetness; dried in the vacuum it presents an amorphous mass, which is deliquescent. It deviates the plane of polarisation to the right, about + 26°; its composition is represented by the formula $C_6H_{14}O_6$, thus an isomer of mannite. At 100° it chars, losing water and giving off an odour of caramel; the composition is then expressed by the formula $C_6H_{12}O_5$. The colouring matter insoluble in water, obtained in the decomposition, is distinguished by its composition and properties from quercitine; its composition may be expressed by the formula $C_{12}H_{10}O_5$. That of rhamnegine is $C_{24}H_{32}O_{14}$. Consequently, in the decomposition the reaction is

$$C_{24}H_{32}O_{14}+3H_2O=C_{12}H_{10}O_5+2(C_6H_{14}O_6).$$

Rhamnegine, heated to 140° with acetic anhydride gives a hexacetic derivative, $C_{24}H_{26}(C_2H_3O)_6O_{14}$, insoluble in water. In the same conditions, rhamnetine gives a diacetic derivative, $C_{12}H_8(C_7H_3O)_2O_5$. There exist in the berries two rhamnegines, α and β isomers, of which one, β, is more soluble in alcohol and more fusible than the other. This one gives, upon splitting up, a rhamnetine soluble and crystallisable in alcohol, while that furnished by the rhamnegine, α, is nearly insoluble in boiling alcohol. The acetic derivatives of the two rhamnetines are distinguished clearly the one from the other by their crystalline form and fusing point. To fix definitely the nomenclature of the products from Persian berries, M. Schützenberger proposes to use the terms rhamnegines, α and β, for the two soluble glucosides—rhamnine for the insoluble glucoside, and rhamnetines α and β for the products derived from the decomposition of the two rhamnegines.

CORRESPONDENCE.

AN EXPERIMENT IN DIAMAGNETISM.

To the Editor of the Chemical News.

Sir,—A new experiment in diamagnetism, which suggested itself to me some time ago, and was realised with complete success, will perhaps be interesting to your readers. The object of the experiment is to show to a large number the diamagnetic action in such a way that it is manifest to all at once. For this purpose a disc of copper is made to revolve between the poles of the magnet by a pulley and band from a steady source of motion—for instance an electro-motive engine. The diamagnetic effect may be made manifest in three ways.

1st. The band is let to run somewhat loosely. As long as the current is not turned into the magnet coils, the disc moves with great velocity. The turning-in of the current instantly stops the disc, forcing the band to slip. Thus motion and stoppage of the disc can be exhibited alternating, until the effect is fully appreciated.

2nd. The band is drawn tight. The turning-in of the current does not now stop the disc, but the great diminution of velocity in the prime mover shows the effort of the magnet to stop the disc. Here, too, alternation may be used as before.

3rd. The axis of the disc carries a small wheel with many teeth; a card held against the teeth of the revolving wheel gives a fine clear high note (Savart's wheel). As long as the magnet is not in action the prime mover keeps up a fixed velocity, and consequently the wheel gives the same note. On turning-in the current, if the band slips the sound stops; if it does not slip the note is changed, from the decreased velocity of the prime mover. The alternations of sound and silence (or change of note) are very striking.

The single fluid Callan battery, of which I wrote to you some time ago, has now proved itself to be a capital working battery for anyone engaged in study. It may be so arranged as to be always ready to give a powerful current of electricity, *e.g.*, such as diamagnetism requires. A student who must look after his own battery will not go to the dreadful work of a ten- or twenty-cell Grove for the experiments of a few minutes.—I am, &c.,

E. Kernan.

Clongowes College,
August, 13, 1868.

QUESTION IN PNEUMATICS.

To the Editor of the Chemical News.

Sir,—Supposing the water of the sea at the depth of 28,050 feet to have a uniform density equal to that of pure water, the submerged air subjected to a pressure of 850 atmospheres would have the same density as the water, and would, consequently, not rise to the surface. But, taking into consideration the compressibility of water—about 1-20,000th of its volume for each atmosphere —the point at which air would have a density equal to that of water at the surface, is 28,000 feet. At this depth, however, water would possess a higher density than at the surface, for contraction of one volume due to a pressure of 850 atmospheres = 1-20,000th × 850 = ·0425. Consequently, the density of water at a depth of 28,000 feet, as compared with that at the surface = 1 ÷ (1 – ·0425) = 1 ÷ ·9575 = 1·044. Hence, the bubble of air would possess buoyancy, and rise to the surface.—I am, &c.,

J. Noble.

MISCELLANEOUS.

St. Mary's Hospital.—Dr. Russell has been appointed Professor of Chemistry in this hospital, in the place of Dr. Matthiessen, who is going to St. Bartholomew's.

The Sale of Poisons.—Among the statutes which received the Royal assent on the day of the prorogation was one to regulate the sale of poisons, and to alter and extend the Pharmacy Act, 1852. The preamble declares it to be expedient, for the safety of the public, that persons keeping open shop for the retailing, dispensing, or compounding of poisons, and persons known as chemists and druggists, should possess a competent practical knowledge of their business; and to that end, from and after the day named in the Act, all persons not already engaged in such business should, before commencing such business, be duly examined as to their practical knowledge, and that a register should be kept; and also that the Pharmacy Act, the 15th and 16th of Victoria, cap. 56, should be amended. From and after the 31st of December next persons selling or compounding poisons, or assuming the title of chemists and druggists, must be registered unless they are pharmaceutical chemists, and must conform to such regulations as to the keeping, dispensing, and selling of such poisons as may from time to time be prescribed by the Pharmaceutical Society, with the consent of the Privy Council. Certain articles mentioned in a schedule annexed to the Act are stated to be poisons, and other articles may be declared to be within the category. Chemists and druggists within the meaning of the Act to consist of all persons who at any time before its passing had carried on in Great Britain the business of a chemist and druggist, in the keeping of open shop; and also of all assistants and associates who before the passing of the Act were registered under the Pharmacy Act, and also all persons as may be registered under the present Act. With the view of protecting the public it is now provided that any person who at the time of the passing of the Act was of full age, and can produce to the Registrar of the Pharmaceutical Society by the 31st of December next, certificates as set forth in the schedule that he had been for a period of not less than three years actually engaged and employed in the dispensing and compounding of prescriptions as an assistant to a pharmaceutical chemist or to a chemist and druggist as defined by the Act, is on passing such a modified examination as the Council of the Pharmaceutical Society, with the consent of the Privy Council, may declare to be sufficient evidence of his skill and competency to conduct the business of a chemist and druggist, be registered as a chemist and druggist under this Act. Those entitled to be registered at the passing of the Act are to be registered without the payment of a fee. The examiners under the Pharmacy Act are to be the examiners under the present one, and the Registrar under the Pharmacy Act to act under this statute. The Council of the Pharmaceutical Society are to make orders for regulating the register to be kept. Every registrar of deaths in Great Britain is required to give notice of the death of a chemist. The evidence of qualification of persons to be registered is to be given to the Registrar, and any appeal from his decision to be to the Council of the Pharmaceutical Society. An annual register is to be kept. Restrictions as to the sale of poisons to be subject to penalties. No poisons are to be sold either by wholesale or retail unless labelled, and poisons are not to be sold to any person unknown to the seller unless introduced by some person known to him, and before the delivery an entry is to be made in a book, and the signature of the purchaser attached, under a penalty of £5 for the first offence. Persons registered under "The Medical Act" are not to be registered under this Act. The Adulteration of Food Act is to extend to medicines. From the passing of the Act all powers vested in the Secretary of State by the Pharmacy Act are to vest in the Privy Council, and power is given to the Privy Council to erase the names of persons from the register. The statute, which is not to extend to Ireland, is to be cited as "The Pharmacy Act, 1868."

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2163. J. F. Cooke, Cannon Street, London, "Improvements in the manufacture of copying ink."—Petition recorded July 8, 1868.

2177. J. Harris, Harefield Iron Works, Middlesex, and V. Pendred, Milton Road, Dulwich, Surrey, "Improvements in the manufacture of wrought iron and steel."—July 9, 1868.

2296. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the production of a red colouring matter."—A communication from A. Clavel, Basle, Switzerland.—July 22, 1868.

2334. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of cast and wrought iron and steel, and in the furnaces employed therefor."—A communication from A. Ponsard and F. E. Boyenval, Paris.—July 24, 1868.

2343. L. Wray, Ramsgate, Kent, "Improved methods of, and apparatus for, obtaining or separating metals from their ores, matrices, slimes, and tailings.—July 25, 1868.

2357. A. M. Clark, Chancery Lane, "Improvements in the manufacture of artificial ice, and in apparatus for the same."—A communication from J. B. Toselli, Boulevart St. Martin, Paris.—July 27, 1868.

2364. J. Webster, Birmingham, "Improvements in the manufacture of gas and vapour, and in applying such gas and vapour in manufacturing and refining iron and other metals, and in recovering certain products therefrom."

2367. C. A. La Mont, New York, U.S.A., "An improved preparation of eggs."—July 28, 1868.

2375. E. Herring, Beer Lane, London, "Improvements in the treatment of saccharine solutions of malt or sugar."

2376. W. R. Lake, "Southampton Buildings, Chancery Lane, "An improved compound to be used as a substitute for linseed oil in the preparation of paint and varnish."—A communication from R. E. Ferguson and B. B. Ferguson, Chicago, Ill., U.S.A.

2381. J. Radcliffe. Consett Hall, Durham, "Improvments in machinery or apparatus employed in the manufacture of iron and steel."

2384. J. Jeffreys, Upper Norwood, Surrey, "Improvements in preserving animal and vegetable substances."—July 29, 1868.

2396. T. Prosser, New York, U.S.A., "Improvements in distillation and in the means or apparatus employed therein."—July 30, 1868.

2404. A. G. Day, Seymour, Conn., U.S.A., "An improved artificial compound, chiefly designed for use as a substitute for india-rubber or caoutchouc."—July 31, 1868.

NOTICES TO PROCEED.

1073. C. F. Claus, Middlesbrough-on-Tees, "Improvements in the manufacture of iron."

1074. C. F. Claus, Middlesbrough-on-Tees, "Improvements in the manufacture of malleable iron, and in the process of re-heating the same for the purpose of rolling or hammering it."—Petitions recorded March 30, 1868.

1117. J. G. Dale, and E. Milner, Warrington, Lancashire, "An improved method of producing white pigments from lead."—April 2, 1868.

1157. J. Radcliffe, Consett Iron Works, Durham, "Improvements in processes and means employed in the manufacture of iron and steel."—April 6, 1868.

1195. A. H. Still and D. Lane, Cork, "Improvements in the manufacture of gas."—April 9, 1868.

2261. D. Webster, Southport Gas Works, Lancashire, "Certain improvements in the manufacture of gas and in apparatus connected therewith."—July 18, 1868.

NOTES AND QUERIES.

Naphthaline Yellow.—Peat Charcoal.—Can you tell me where I can procure a small quantity of naphthaline yellow? Also where I can obtain a cask of peat charcoal, and at what price?—J. N.

Spectroscope.—Will you kindly allow me to ask through the medium of your most useful "Notes and Queries," if the improved spectroscope designed by Professor Osborn, of Lafayette College, Easton, Pennsylvania, and noticed in the Chemical News of 14th February, p. 84, is to be had in this country, and if so where?—Fred. J. Rowan.

Embalming.—I remember seeing an account of a method of embalming anatomical specimens in such a manner that their flexibility was not impaired, whilst the tendency to decompose was entirely prevented. I believe the vessels were first washed out with water, alcohol, and ether, and then injected with solution of tannin or some such substance. Can any of my fellow readers kindly supply more precise information and oblige—A Physician?

Yeast.—In the issue of Chemical News for June 5, page 268, there is a paper quoted from the *American Artizan*, on the "Adulterations and Falsifications of Bread." The second sentence reads "Under the influence of heat, water, and *acid yeasts* it often developes in that food cryptogamic vegetations." Will any of your numerous readers be good enough to tell me what is meant by *acid yeasts*, and what is that which is frequently added to ordinary yeast to make it quicker and more energetic as a ferment in dough?—A Constant Subscriber.

Estimation of Antimony.—When antimony is precipitated in the form of sulphide, it is safest to convert it into antimoniate of oxide of antimony (Sb_2O_3,Sb_2O_5) by complete oxidation with fuming nitric acid in a weighed porcelain crucible. To avoid ignition, the substance must be moistened with a few drops of dilute acid before adding the fuming acid. A prolonged digestion effects the complete solution of the pulverulent precipitate of sulphur. The excess of acid is then evaporated off carefully, and the residue calcined.—F. Wöhler.

Preparation of Sulphurous Anhydride.—A current of sulphurous anhydride is obtained by stacking, by means of copper, pure sulphuric acid, *diluted with from half to two-fifths its volume of water*. To make sure of the purity of the sulphurous anhydride I pass the current, at first through water contained in a large washing flask, then through two Woulf's bottles completely filled with pumice stone broken into small fragments and moistened. The moistened pumice stone, previous to its introduction into the bottles is twice calcined with sulphuric acid, so as to free it from the chlorides and fluorides which it often contains.—J. S. Stas.

TO CORRESPONDENTS.

W. A. Ross, Capt. R.A.—We regret that your communication is unsuitable for our pages.

Tessié du Motay.—A correspondent favours us with the following:—"The French Exhibition gives the address of Tessié du Motay as under:—Tessié du Motay et Karcher, à Metz, Moselle."

H. Deschamps.—In tempering articles of steel, a temperature of 430° F. is used for lancets, 530° F. for watch springs, and 590° for large saws.

A Physician.—We are aware that the statement has been made that solutions of arsenious acid are constantly employed by poulterers and others for washing over poultry, game, &c., with the view of keeping them superficially fresh, but we do not believe it.

X. Y. Z.—We shall be very happy to allow you to refer to the book in question, and will let it remain at our office all next week. Being a rare book, we should be unwilling to lend it.

Puzzled.—The numbers have been regularly posted to the address you gave. None have come back here through the Dead Letter Office, so it is certain they were delivered properly.

W. Harvey.—Talc may be occasionally obtained in very clear pieces, 1 foot square, but not so clear as glass. Split thin, the sheets bend easily, but they will not stand rough usage, as they are scratched readily and easily flake off.

A. D. U—If you will send a small piece of the deposit in a letter, we will tell you whether it is sulphate or carbonate of lime. Dilute acid will dissolve carbonate, but not sulphate. But "a reader of the Chemical News from the commencement," as you say you are, has profited very little by it if he is obliged to ask the Editor's advice in so very simple a case.

As.—Tersulphide of arsenic is not absolutely insoluble in water. Fresenius states that it dissolves in one million times its weight.

W. St. M.—The bill has been withdrawn; your letter, therefore, is not required.

Communications have been received from M. A. Whichelo; F. C. Calvert and Co.; Mottershead and Co.; J. Muspratt and Sons (with enclosure); E. Hunt (with enclosure); G. W. Eccles; E. Cetti and Co.; P. Squire; Dr. Horace Dobell (with enclosure); H. Yeates; E. Meldrum (with enclosure); J. Hardman; G. Pearson; Dr. T. Wood; D. T. Hughes, California (with enclosure); W. J. Wonfor; and Captain W. A. Ross, R.A.

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Appendix A containing additional information on Sulphur, Sulphuric Acid, Bisulphide of Carbon, Chloride of Sodium, Soda, Hydrochloric Acid, Potash, Soap, Glycerin, Aluminium and Sodium, Magnesium, Soluble Stannates, Arseniate of Soda, Silicates of Potash and Soda., Chlorate of Potash, Phosphorus, Lucifer Matches, Hyposulphite of Soda, Boracic Acid, Soluble Phosphates, Nitrate of Soda, Gunpowder, Gun-cotton, Nitroglycerine, and Prussiate of Potash.

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THE CHEMICAL NEWS.

Vol. XVIII. No. 456.

BRITISH ASSOCIATION
FOR THE
ADVANCEMENT OF SCIENCE.

Norwich Meeting, Wednesday August 19, 1868.

INAUGURAL ADDRESS OF THE PRESIDENT

Joseph Dalton Hooker, Esq., F.R.S., D.C.L.,
Director of the Royal Gardens, Kew.

(Concluded from page 93.)

Ten years have elapsed since the publication of "The Origin of Species by Natural Selection," and it is therefore not too early now to ask what progress that bold theory has made in scientific estimation.

The most widely-circulated of all the journals that give science a prominent place on their title-pages—the *Athenæum*—has very recently told to every country where the English language is read, that Mr. Darwin's theory is a thing of the past, that natural selection is rapidly declining in scientific favour, and that, as regards the above two volumes on the variations of animals and plants under domestication, they "contain nothing more in support of origin by selection than a more detailed reasseveration of his guesses founded on the so-called variations of pigeons."

Let us examine for ourselves into the truth of these inconsiderate statements.

Since the "Origin" appeared, ten years ago, it has passed through four English editions, two American, two German, two French, several Russian, a Dutch, and an Italian; whilst of the work on variation, which first left the publisher's house not seven months ago, two English, a German, Russian, American, and Italian editions are already in circulation. So far from natural selection being a thing of the past, it is an accepted doctrine with almost every philosophical naturalist, including, it will always be understood, a considerable proportion who are not prepared to admit that it accounts for all Mr. Darwin assigns to it.

Reviews on "The Origin of Species" are still pouring in from the continent, and Agassiz, in one of the addresses which he issued to his *collaborateurs* on their late voyage to the Amazons, directs their attention to this theory as a primary object of the expedition they were then undertaking. I need only add, that of the many eminent naturalists who have accepted it, not one has been known to abandon it; that it gains adherents steadily, and that it is, *par excellence*, an avowed favourite with the rising schools of naturalists; perhaps, indeed, too much so, for the young are apt to accept such theories as articles of faith, and the creed of the student is but too likely to become the shibboleth of the future professor.

The scientific writers who have publicly rejected one or both of the theories of continuous evolution and of natural selection, take their stand upon physical or metaphysical grounds, or both. Of those who rely on the metaphysical, their arguments are usually strongly imbued with theological prejudice and even odium, and, as such, are beyond the pale of scientific criticism. Having myself been a student of moral philosophy in a northern university, I entered on my scientific career full of hopes that metaphysics would prove a useful mentor, if not a guide in science. I soon, however, found that it availed me nothing, and I long ago arrived at the conclusion, so well put by Agassiz, when he says, "we trust that the time is not distant when it will be universally understood that the battle of the evidences will have to be fought on the field of physical science, and not on that of metaphysical."[*] Many of the metaphysicians' objections have been controverted by that champion of natural selection, Mr. Darwin's true knight, Alfred Wallace, in his papers on "Protection"[†] and "Creation by Law,"[‡] &c., in which the doctrines of "continual interference" the "Theory of Beauty," and kindred subjects, are discussed with admirable sagacity, knowledge, and skill. But of Mr. Wallace and his many contributions to philosophical biology it is not easy to speak without enthusiasm, for, putting aside their great merits, he, throughout his writings, with a modesty as rare as I believe it to be in him unconscious, forgets his own unquestioned claims to the honour of having originated, independently of Mr. Darwin, the theories which he so ably defends.

On the score of Geology, the objectors chiefly rely on the assumed perfection of the geological record; and since almost all who believe in its imperfection, and many of the other school, accept the theories both of evolution and natural selection, wholly or in part, there is no doubt but Mr. Darwin claims the great majority of geologists. Of these one is in himself a host—the veteran Sir Charles Lyell—who, after having devoted whole chapters of the first editions of his "Principles" to establishing the doctrine of special creations, abandons it in the tenth, and this, too, on the shewing of a pupil; for, in the dedication of his earliest work, "The Naturalist's Voyage," to Sir C. Lyell, Mr. Darwin states that the chief part of whatever merit he or his works may possess has been derived from studying the "Principles of Geology." I know no brighter example of heroism of its kind than this, of an author thus abandoning late in life a theory which he had for forty years regarded as one of the foundation stones of a work that had given him the highest position attainable amongst contemporary scientific writers. Well may he be proud of a superstructure raised on the foundations of an insecure doctrine when he finds that he can underpin it, and substitute a new foundation, and, after all is finished, survey his edifice, not only more secure, but more harmonious in its proportions than it was before; for assuredly the biological chapters of the tenth edition of the "Principles" are more in harmony with the doctrine of slow changes in the history of our planet than were their counterparts in the former editions.

To the astronomers' objections to these theories I turn with diffidence; they are strenuously urged in what is in my opinion the cleverest critique of them that I have hitherto met with, and which appeared in the *North British Review*. It is anonymous—I am wholly ignorant of its author; and I regret to find, that, in common with the few other really able hostile critiques, it is disfigured by a dogmatism that contrasts unfavourably with Mr. Darwin's considerate treatment of his opponents' methods and conclusions. The author starts, if I read him aright, by professing his unfamiliarity with the truth and extent of the facts upon which the theories of evolution and natural selection are founded, and goes on to say, that "the superstructure based on them may be discussed apart from all doubts as to the fundamental facts." The liberty thus to discuss no one may dispute or curtail, but the biologist will ask, to what end can such discussion lead? Who would attach much weight to the verdict of a judge passed on evidence of which he knew neither the truth nor the extent? As well might a boy, guiltless of mathematics, set himself to test the 47th proposition of the 1st book of Euclid, by constructing paper squares corresponding to the sides of a right-angled triangle, then cutting up the smaller squares, try to fit the pieces into the larger, and failing to do this with exactitude, conclude of the problem, as the reviewer does of the theory, that it is "an ingenious and plausible speculation, marking at once the ignorance of the age and the ability of the philosopher."

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[*] Agassiz on the Contemplation of God in the Kosmos. *Christian Examiner*, 4th series, vol. xv., p. 2.

[†] *Westminster Review*.

[‡] *Journal of Science*, October, 1867.

The most formidable argument urged by the reviewer is, that "the age of the inhabited world as calculated by solar physics, is proved to have been limited to a period wholly inconsistent with Darwin's views." This would be a valid objection if these views depended on those of one school of geologists; and if the 500,000,000 years, which the reviewer adopts as the age of the world, were, as an approximate estimate, accepted by either astronomers or physicists. But in the first place the reviewer assumes that the rate of change in the condition of the earth's surface was vastly more rapid at the beginning than now, and has gradually slackened since; but overlooks the consequence, that according to all Mr. Darwin's principles, the operations of natural selection must in such cases have been formerly correspondingly more rapid; and in the second, are the speculations as to the solidity of the earth's crust, dating back only 500,000,000 years, to be depended upon? In his great work the author[*] quotes for these numbers, gives as possible limits 20,000,000, or 400,000,000 years; whilst other philosophers assign to the habitable globe an age far exceeding the longest of these periods. Surely, in estimates of such a nature as the above, which are calculated from data themselves in a great degree hypothetical, there are no principles upon which we are warranted in assuming the speculations of the astronomer to be more worthy of confidence than those of the biologist.

A former most distinguished president, and himself an astronomer, Professor Whewell, has said of Astronomy "that it is not one of the lessons of science, but the one of perfect science, the only branch of human knowledge in which we are able fully and clearly to interpret Nature's oracles; so that by that which we have tried we receive a prophecy of that which is untried."[*] Now, whilst fully admitting, and proudly as every scientific man ought, that Astronomy is the most certain in her methods and results of all sciences, that she has called forth some of the highest efforts of the intellect, and that her results far transcend in grandeur those of any other science, I think we may hesitate before we therefore admit her queenship, her perfection, or her sole claims to interpretation and to prophecy. Her methods are those of the mathematicians; she may call geometry and algebra her handmaidens, but she is none the less their slave. No science is really perfect, certainly not that which lately erred 2,000,000 miles in so fundamental a datum as the earth's distance from the sun. Have Faraday and Von Baer interpreted no oracles of Nature fully and clearly? Have Cuvier and Dalton not prophesied and been true prophets?

Claims to queenship do not accord with the spirit of science; neither would I liken the domain of natural knowledge to a hive, in which every comb is a science, and truth the one queen over them all.

It remains to say a few words on some prospects which this Norwich meeting opens.

A new science has dawned upon us; that of the early history of mankind. Pre-historic Archæology (including as it does the origin of language and of art) has been the latest to rise of a series of luminaries that have dispelled the mists of ages and replaced time-honoured traditions by scientific truths. Astronomy, if not the queen, yet the earliest of sciences, first snatched the torch from the hands of dogmatic teachers, tore up the letter and cherished the spirit of the law. Geology next followed, but not till two centuries had elapsed, nor, indeed, till this our day in divesting religious teaching of many cobwebs of scientific error. It has told us that animal and vegetable life preceded the appearance of man on the globe, not by days but by myriads of years, and how late this knowledge came we may gather from the fact, that Lawrence in his previously quoted lectures,[*] delivered so late as 1818, says of the extinct races of animals, that "their living existence has been supposed, with considerable probability," to be of older date than the formation of the human race.

And, last of all, this new science proclaims man himself to have inhabited this earth for, perhaps, many thousands of years before the historic period,—a result little expected less than thirty years ago when the Rev. W. V. Harcourt, in his address to the Association at Birmingham,[†] observed that "Geology points to the conclusion that the time during which man has existed on the globe, cannot materially differ from that assigned by scripture," referring, I need not say, to the so-called scripture chronology, which has no warrant in the Old Testament, and which gives 5874 years as the age of the inhabited globe.

Pre-historic Archæology now offers to lead us where man has hitherto not ventured to tread. Can we, whilst truthfully and fearlessly pursuing this inquiry, separate its physical from its spiritual aspect? will be the uppermost thought in the minds of many here present: to separate them is, I believe, indeed impossible, but to search out common truths that underlie both is permitted to all. Mr. Disraeli,[‡] has well said of truth, that it is the sovereign passion of mankind. And it should be emphatically so in the minds engaged in this search, where religion and science should speak peace to one another, if they are to walk hand in hand in this our day and generation.

A great deal has of late been said and written about the respective attitudes of Religion and Science; and my predecessor, the Duke of Buccleuch, dwelt on this in his address last year with great good sense and good taste, and pointed out how much the progress of knowledge depended on this attitude being mutually considerate and friendly. During the first decades of my scientific life, science was rarely, within my experience, heard of from the pulpits of these islands: during the succeeding, when the influence of the *reliquiæ diluvianæ* and the Bridgewater treatises was still felt, I often heard it named, and always welcomed. Now, and of late years, science is more frequently named than ever, but too often with dislike or fear rather than with trust and welcome.

The Rev. Dr. Hanna, in an eloquent and candid contribution to the *Contemporary Review*,[||] has adduced a long list of eminent clergymen of various denominations who have adorned science by their writings and religion by their lives: I do not ignore their contributions, still less do I overlook the many brilliant examples of educated preachers who give to science the respect due to it. But Dr. Hanna omits to observe that the majority of these honoured contributors were not religious teachers in the ordinary sense of the term: nor does he tell us in what light many of their scientific writings were regarded by a large body of their brother clergymen, those resident in the country especially, from whom alone an overwhelming proportion of the population ever hear the name of science.

In return, let each pursue the search for truth, the archæologist into the physical, the religious teacher into the spiritual history and condition of mankind. It will be in vain that each regards the other's pursuit from afar, and turning the object glass of his mind's telescope to his eye, is content when he sees how small the other looks.

To search out the whence and whither of his existence is an unquenchable instinct of the human mind; to satisfy it, man in every age, and in every country, has adopted creeds that embrace his past history and his future being; and has eagerly accepted scientific truths that support the creeds; and but for this unquenchable instinct, I for one believe, that neither religion nor science would have advanced so far as they have into the hearts of any people. Science has never in this search hindered the religious aspirations of good and earnest men; nor have pulpit cautions, which are too often the ill-disguised deterrents, ever turned inquiring minds from the revelations of science.

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[*] Thomson and Tait, Treatise on Natural Philosophy, vol. i., p. 716.

[*] Rev. W. Whewell. Reports, 1833, p. xiii.

[*] Lectures on Physiology, Zoology, &c., p. 52.

[†] Reports, p. 17.

[‡] Life of Lord George Bentinck.

[||] Vol. vi., No. 21, September, 1867.

A sea of time spreads its waters between that period to which the earliest traditions of our ancestors point, and that far earlier period when man first appeared upon the globe. For his track upon that sea man vainly questions his spiritual teachers. Along its hither shore, if not across it, science now offers to pilot him. Each fresh discovery concerning pre-historic man is as a pier built on some rock its tide has exposed, and from these piers arches will one day spring that will carry him further and further across its depths.

Science, it is true, may never sound the depths of that sea, may never buoy its shallows, or span its narrowest creeks, but she will still build on every tide-washed rock; nor will she deem her mission fulfilled till she has sounded its profoundest depths and reached its further shore, or proved the one to be unfathomable and the other unattainable, upon evidence not yet revealed to mankind. And if in her tracks he bears in mind that it is a common object of religion and of science to seek to understand the infancy of human existence—that the laws of mind are not yet relegated to the domain of the teachers of physical science, and that the laws of matter are not within the religious teacher's province, these may then work together in harmony and with good will.

But if they would thus work in harmony, both parties must beware how they fence with that most dangerous of all two-edged weapons, Natural Theology—a science falsely so called when, not content with trustfully accepting truths hostile to any presumptuous standard it may set up, it seeks to weigh the infinite in the balance of the finite, and shifts its ground to meet the requirements of every new fact that science establishes, and every old error that science exposes. Thus pursued, Natural Theology is to the scientific man a delusion, and to the religious man a snare, leading too often to disordered intellects and to atheism.

One of our deepest thinkers,[*] Mr. Herbert Spencer, has said:—"If religion and science are to be reconciled, the basis of the reconciliation must be this deepest, widest, and most certain of facts, that the power which the universe manifests to us is utterly inscrutable." The bonds that unite the physical and spiritual history of man, and the forces which manifest themselves in the alternate victories of mind and of matter over the actions of the individual, are, of all the subjects that physics and psycology have revealed to us, the most absorbing and are, perhaps, utterly inscrutable. In the investigation of their phenomena is wrapped up that of the past and the future, the whence and the whither, of his existence; and, after a knowledge of these, the human soul still yearns, and thus passionately cries, in the words of a living poet,[†]

"To matter or to force
The all is not confined;
Beside the law of things
Is set the law of mind;
One speaks in rock and star,
And one within the brain,
In unison at times,
And then apart again;
And both in one have brought us hither,
That we may know our whence and whither.

The sequences of law
We learn through mind alone;
We see but outward forms,
The soul the one thing known;—
If she speak truth at all,
The voices must be true
That give these visible things,
These laws their honour due,
But tell of One who brought us hither,
And holds the keys of whence and whither.

* * * * * *

He in His science plans,
What no known laws foretell;
The wandering fires and fix'd
Alike are miracle:
The common death of all,
The life renewed above,
Are both within the scheme
Of that all-circling love.
The seeming chance that cast us hither,
Accomplishes his whence and whither."

REPORT OF THE KEW COMMITTEE
OF THE
BRITISH ASSOCIATION
FOR THE
ADVANCEMENT OF SCIENCE FOR 1867-68.

THE committee of the Kew Observatory submit to the Council of the British Association the following statement of their proceedings during the past year:—

The meteorological office, to which allusion was made in the last report, continues in operation, Kew being the central observatory, as arranged with the meteorological committee appointed by the Council of the Royal Society. In consequence of this arrangement there has been during the past year a considerable access of work to the Kew Observatory, and the duties undertaken by that establishment may, as in the last report, for clearness' sake, be again considered under the two following heads;—

(A) The work done by the Kew Observatory under the direction of the British Association.
(B) That done at Kew as the Central Observatory of the Meteorological Committee.

This system of division will therefore be adopted in this report; but it ought to be mentioned that the financial statement appended to it refers only to the first of these divisions, since the work done at Kew for the meteorological committee has been paid from funds supplied by the committee, and not in any way from money subscribed by the British Association.

(A) WORK DONE BY KEW OBSERVATORY UNDER THE DIRECTION OF THE BRITISH ASSOCIATION.

1. *New Instruments for Colaba Observatory.*—The chairman of the Kew committee, shortly after the meeting at Dundee, received a communication from Mr. Chambers, the superintendent of the Colaba Observatory, Bombay, requesting the support of the Kew committee in his application to the India Board for a supply of self-recording magnetographs and other instruments required for his observatory. This was ultimately brought before the Council of the British Association; and in consequence of the steps taken, Sir Stafford Northcote, in a letter to General Sabine, dated 30th January, 1868, sanctioned the supply of new instruments for the observatory at Bombay, while General Sabine, on behalf of the Kew committee, undertook to select the following instruments required:—

(1) A set of self-recording magnetometers for registering by photography changes of declination, horizontal force, and vertical force.
(2) Thomson's electrometer, arranged for photographic self-registration.
(3) A self-recording barograph and thermograph, of the pattern adopted by the meteorological committee (added afterwards).
(4) Apparatus for measuring and tabulating the curves given by the above-named instruments.
(5) Photographic apparatus, porcelain dishes, and boxes for paper and photograms.
(6) Moffat's ozonometer, in box with clockwork and rotating cylinder.

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[*] First Principles, by Herbert Spencer, Ed. ii., page 46.
[†] The Reign of Law, by F. T. Palgrave. *Macmillan's Magazine*, March, 1867.

(7) Beam-compasses, with steel points and tangent screw adjustment to measure 4 feet (for verification of distances in deflection experiments).
(8) Rotating frame with large glass jar for testing thermometers.

2. *Magnetic work.*—The self-recording magnetographs, ordered by the India Board for Mr. Chambers, have been verified at Kew, and returned to the India Office, from which they have been doubtless despatched ere this to Bombay.

A differential declinometer (received from General Sabine's office) has been verified at Kew for Dr. Lemström, who has gone out as physical observer with the Spitzbergen expedition.

A unifilar has been received at Kew for Mr. Meldrum, of the Mauritius Observatory, and its constants are in process of being determined.

Senhor Viegas, of Coimbra, and Lieutenant Ielagin, of the Imperial Russian Navy, have received magnetic instruction at Kew; and a dip-circle has been prepared for the latter gentleman, who purposes making observations with it at the various European Observatories.

The usual monthly absolute determinations of the magnetic elements continue to be made by Mr. Whipple, magnetic assistant; and the self-recording magnetographs are in constant operation as heretofore, also under Mr. Whipple, who has displayed much care and ability in the discharge of his duties.

The photographic department connected with the self-recording instruments is under the charge of Mr. Page, assisted by Mr. Foster, both of whom discharge their duties very satisfactorily.

An arrangement connected with the instrumental clock for shutting off the light every two hours, and thereby increasing the accuracy of the time scale, originally devised by Mr. Beckley, in connection with the self-recording meteorological instruments, has been adapted to the Kew, and also to the Mauritius and Bombay self-recording magnetographs, and the time-scale of the Kew magnetographs has been made the same as those of the other instruments.

It was proposed in the last report that the task of tabulating and reducing the magnetic curves produced at Kew subsequently to January, 1865, should be performed by the staff at Kew working under the direction of Mr. Stewart. In accordance with this resolution 787 curves, being those of the declination from February, 1865, to April, 1867, have been measured for every hour, aud the process of reduction of these measurements is well advanced.

The magnetical observations made at Ascension by Lieutenant Rokeby, R.M., have been nearly reduced by Mr. Whipple, and it is proposed to communicate the results to the Royal Society.

A comparison of the Kew and Lisbon magnetic curves during the magnetic storm of February 20-25, 1866, made by Senhor Capello, of the Lisbon Observatory, has been communicated to the Royal Society, and will be found published in their proceedings for May 28, 1868.

Mr. Stewart has likewise received from Senhor Capello a short paper "On the reappearance of certain periods of declination disturbance during two, three, or several days," which he proposes to communicate to the Royal Society.

The Rev. W. Sidgreaves and Mr. Stewart have been engaged in making intercomparisons of simultaneous disturbances of the declination at Stonyhurst and Kew, for both of which stations the instruments have the same scale. It would appear from these that during slow disturbances there is an absolute identity between the indications of the two instruments, even to their most minute features. On the other hand, the more abrupt disturbances appear to be exaggerated at Stonyhurst as compared with Kew to an extent which appears (at first sight) to depend upon the abruptness. Messrs. Sidgreaves and Stewart are investigating this phenomenon, which has clearly a physical and not an instrumental origin, and purpose communicating their results in a joint paper to the Royal Society.

3. *Meteorological Work.*—The meteorological work of the Observatory continues in the charge of Mr. Baker, who executes his duties very satisfactorily.

Since the Dundee meeting seventy-eight barometers have been verified, and seventy-one are at present in hand; 1,139 thermometers have likewise been verified, and fourteen standard thermometers have been constructed for the thermographs of the meteorological committee. Thirty-two thermograph thermometers have likewise been tested, twenty-four of these being for the meteorological committee and eight for opticians.

The self-recording meteorological instruments now at work at Kew will be again mentioned in the second division of this report. These are in the charge of Mr. Baker, the photography being superintended by Mr. Page.

Mr. Robert Addams has kindly made a preliminary experiment with his apparatus for freezing carbonic acid, which is now at Kew, and has also left specific instructions regarding it, so that the operation can in future be performed without assistance. The point corresponding to the temperature of freezing mercury has been determined for two thermometers belonging to the meteorological committee.

The self-recording barographs, thermographs, and anemographs for the six outlying observatories of the meteorological committee have been verified at Kew. A self-recording barograph and thermograph have likewise been verified for Messrs. R. and J. Beck, opticians; and the verification of another set for Mr. Chambers, of the Colaba Observatory, has been very recently completed.

The experiments made on aneroids at Kew, by the request and at the expense of the meteorological committee, have formed the subject of a communication recently made to the Royal Society by that body.

4. *Photoheliograph.*—The Kew heliograph, in charge of Mr. De la Rue, continues to be worked in a satisfactory manner. During the past year 224 negatives have been taken on 140 days. Ninety pictures of the Pagoda in Kew Gardens have likewise been taken, in the hope of being able by this means to determine accurately the angular diameter of the sun.

Since the last meeting of the Association, a series of solar researches, in continuation of the second series, has been published (the expense of printing having been defrayed by Mr. De la Rue), entitled "Researches on solar physics. Appendix to second series.—On the distribution in heliographic latitudes of the sun-spots observed by Carrington; by Messrs. De la Rue, Stewart, and Loewy."

Two papers have likewise been communicated to the Royal Society by these gentlemen. The first of these is entitled "Researches on solar physics. Heliographical positions and areas of sun-spots observed with the Kew photoheliograph during the years 1862 and 1863."

The second is entitled "Account of some recent observations on sun-spots, made at the Kew Observatory."

Sun-spots continue likewise to be numbered after the manner of Hofrath Schwabe; and a table, exhibiting the monthly groups observed at Dessau and at Kew for the year 1867 has been communicated to the Astronomical Society, and published in their monthly notices.

The measurements of the Kew pictures for the year 1864 are approaching completion; when complete they will be communicated to the Royal Society. It is intended to work up rapidly the back years, preparatory to a final discussion.

Mr. De la Rue has recently received a letter from M. Struve, in which it is stated that the arrival at Kew of M. Berg, of the Wilna Observatory, in order to practise with the photoheliograph, may be shortly expected.

5. *Apparatus for Verifying Sextants.*—Several determinations have been made of the angular distances between the collimators of this instrument; but the result appears to indicate a greater want of fixedness in these than is desirable. Should, however, the apparatus come to be

extensively employed for the verification of sextants, this may be overcome by means of frequent determinations of these angular distances by a theodolite.

6. *Miscellaneous Work.*—The time and attention of the Observatory Staff has been so much absorbed during the last year with the regular work of the Observatory that little or no progress has been made in miscellaneous experiments.

The instrument devised by Mr. Broun for the purpose of estimating the magnetic dip by means of soft iron, remains at present at the Observatory, awaiting Mr. Broun's return to England.

The Superintendent has received grants from the Royal Society for special experiments; and when these are completed an account will be rendered to that Society.

(B) WORK DONE AT KEW AS THE CENTRAL OBSERVATORY OF THE METEOROLOGICAL COMMITTEE.

This work may be divided into four heads, the first of these being the arrangement of self-recording meteorological instruments, their verification at Kew, and erection at the various stations; the second being the arrangement of a system of tabulating from the automatic records of these instruments; the third being the arrangement of a system by means of which the continued accuracy of the instruments themselves, and of their tabulated records, may be secured; while the fourth is the work done at Kew as being itself one of the Observatories of the meteorological committee.

1. *Arrangement, Verification, and Erection of Self-recording Instruments.*—In the last report of this committee a short account was given of the principles of construction of the system of self-recording meteorological instruments arranged at Kew, comprising the thermograph, barograph, and anemograph. A more detailed account has since been given by the meteorological committee in their report to Parliament for the year 1867, and it is therefore unnecessary to enter here into the subject. It ought, however, to be mentioned that the principle adopted in these instruments is to check the accuracy of their automatic records by means of reference to standards; and with this view the Kew committee have constructed a standard wet and dry bulb thermometer for each thermograph, and have verified a standard barometer for each barograph. When the various self-recording instruments had been completed by the opticians, they were sent to Kew, where they were examined and verified. They were then despatched to their respective stations in charge of the observer, who had been previously instructed at Kew; and finally, Mr. Beckley, mechanical assistant at Kew, went to the various stations and superintended the erection of the instruments. By his aid this was accomplished in a very thorough and satisfactory manner.

2. *System of Tabulation.*—It is not proposed to discuss here the system of tabulation. This has already been done, to a certain extent, in the report of the meteorological committee presented to Parliament; and the whole subject will, it is hoped, be fully treated of on some future occasion. Suffice it to say, that the system of tabulation was arranged at Kew, and that the tabulating instruments were all verified there before being sent to their respective observatories.

3. *Verification of Records.*—It has already been mentioned that the competency of the observers at the various stations to undertake the charge of the self-recording instruments was secured by a course of instruction at Kew, where they became acquainted with the principles of construction of the various instruments, with the photographic process necessary to obtain curves, and with the system of tabulation. In addition to this, the instruments were erected at the various stations by Mr. Beckley, and each observer was thus well started. It is not, however, enough in a project of this nature to secure a good beginning; it is, moreover, indispensable to see that the standard of excellence is maintained.

For this purpose it is proposed by the meteorological committee that Mr. Stewart should personally visit all the observatories every year; in addition to which some one of the Kew assistants might occasionally visit some station with a specific object in view. Mr. Stewart has already visited Stonyhurst, Glasgow, and Aberdeen; and, in addition to the preliminary visit to the various stations made by Mr. Beckley, Mr. Whipple has visited Falmouth.

Besides this inspection, it is also necessary to check at Kew the accuracy of the tabulated results that arrive there from the various stations. A close and constant scrutiny of these results is therefore made at Kew; and when any error is detected, it is brought before the notice of the observer who made it. All this involves a very considerable amount of labour, more especially at the commencement of the undertaking, and until the various observatories are in thorough working order. For the purpose of securing accuracy and uniformity in the reduction of the records of these instruments, it has been proposed that a set of rules should be drawn up under the sanction of this committee.

4. *Work done at Kew as one of the Observatories of the Meteorological Committee.*—This consists in keeping the barograph, thermograph, and anemograph furnished by the meteorological committee in constant operation. The barograph is erected in the room which contains the magnetographs, and which has a very small daily range of temperature. The outer part of the thermograph is attached to the north side of the observatory, towards the west, while the anemograph has been erected above the centre of the dome, so as not to interfere with the photoheliograph.

For the first two of these instruments traces in duplicate are obtained, one set being sent to the meteorological office, and one retained at Kew; as regards the anemograph, the original records are sent, while a copy of these on tracing-paper is retained.

The tabulations from the curves of the Kew instruments, and the examination of the results forwarded to Kew from the outlying observatories, so far as this last is not personally done by Mr. Stewart, are performed in a very satisfactory manner by Messrs. Whipple, Baker, and Page.

Mr. Steventon, a nephew of Captain Toynbee, of the meteorological office, has been in attendance at the observatory for instruction for about twelve months, and latterly has given much assistance in the meteorological department of the observatory, with the details of which he is now fully conversant.

J. P. Gassiott,
Chairman.

Kew Observatory,
7th August, 1868.

Section A.

ADDRESS
TO THE
MATHEMATICAL AND PHYSICAL SCIENCE SECTION.

August 19, 1868,

By Professor TYNDALL, LL.D., F.R.S., &c., President.

The celebrated Fichte, in his lectures on the "Vocation of the Scholar," insisted on a culture for the scholar which should not be one-sided, but all-sided. His intellectual nature was to expand spherically, and not in a single direction. In one direction, however, Fichte required that the scholar should apply himself directly to nature, become a creator of knowledge, and thus repay, by original labours of his own, the immense debt he owed to the labours of others. It was these which enabled him to supplement the knowledge derived from his own researches, so as to render his culture rounded, and not one-sided.

Fichte's idea is to some extent illustrated by the constitution and the labours of the British Association. We have here a body of men engaged in the pursuit of natural knowledge, but variously engaged. While sympathising with each of its departments, and supplementing his culture by knowledge drawn from all of them, each student amongst us selects one subject for the exercise of his own original faculty—one line along which he may carry the light of his private intelligence a little way into the darkness by which all knowledge is surrounded. Thus, the geologist faces the rocks; the biologist fronts the conditions and phenomena of life; the astronomer stellar masses and motions; the mathematician the properties of space and number; the chemist pursues his atoms, while the physical investigator has his own large field in optical, thermal, electrical, acoustical, and other phenomena. The British Association, then, faces Nature on all sides, and pushes knowledge centrifugally outwards, while, through circumstance or natural bent, each of its working members takes up a certain line of research in which he aspires to be an original producer, being content in all other directions to accept instruction from his fellow men. The sum of our labours constitutes what Fichte might call the sphere of natural knowledge. In the meetings of the Association it is found necessary to resolve this sphere into its component parts, which take concrete form under the respective letters of our sections.

This Section (A) is called the Mathematical and Physical Section. Mathematics and physics have been long accustomed to coalesce, and hence this grouping. For while mathematics, as a product of the human mind, is self-sustaining and nobly self-rewarding,—while the pure mathematician may never trouble his mind with considerations regarding the phenomena of the material universe, still the form of reasoning which he employs, the power which the organisation of that reasoning confers, the applicability of his abstract conceptions to actual phenomena, render his science one of the most potent instruments in the solution of natural problems. Indeed, without mathematics, expressed or implied, our knowledge of physical science would be friable in the extreme.

Side by side with the mathematical method we have the method of experiment. Here, from a starting-point furnished by his own researches or those of others, the investigator proceeds by combining intuition and verification. He ponders the knowledge he possesses and tries to push it further, he guesses and checks his guess, he conjectures and confirms or explodes his conjecture. These guesses and conjectures are by no means leaps in the dark; for knowledge once gained casts a faint light beyond its own immediate boundaries. There is no discovery so limited as not to illuminate something beyond itself. The force of intellectual penetration into this penumbral region which surrounds actual knowledge is not dependent upon method, but is proportional to the genius of the investigator. There is, however, no genius so gifted as not to need control and verification. The profoundest minds know best that Nature's ways are not at all times their ways, and that the brightest flashes in the world of thought are incomplete until they have been proved to have their counterparts in the world of fact. The vocation of the true experimentalist is the incessant correction and realisation of his insight; his experiments finally constituting a body, of which his purified intuitions are, as it were, the soul.

Partly through mathematical, and partly through experimental research, physical science has of late years assumed a momentous position in the world. Both in a material and in an intellectual point of view it has produced, and it is destined to produce, immense changes—vast social ameliorations, and vast alterations in the popular conception of the origin, rule, and governance of things. Miracles are wrought by science in the physical world, while philosophy is forsaking its ancient metaphysical channels, and pursuing those opened or indicated by scientific research. This must become more and more the case as philosophic writers become more deeply imbued with the methods of science, better acquainted with the facts which scientific men have won, and with the great theories which they have elaborated.

If you look at the face of a watch, you see the hour and minute-hands, and possibly also a second hand, moving over the graduated dial. Why do these hands move, and why are their relative motions such as they are observed to be? These questions cannot be answered without opening the watch, mastering its various parts, and ascertaining their relationship to each other. When this is done, we find that the observed motion of the hands follows of necessity from the inner mechanism of the watch when acted upon by the force invested in the spring.

This motion of the hands may be called a phenomenon of art, but the case is similar with the phenomena of Nature. These also have their inner mechanism, and their store of force to set that mechanism going. The ultimate problem of physical science is to reveal this mechanism, to discern this store, and to show that from the combined action of both the phenomena of which they constitute the basis must of necessity flow.

I thought that an attempt to give you even a brief and sketchy illustration of the manner in which scientific thinkers regard this problem would not be uninteresting to you on the present occasion; more especially as it will give me occasion to say a word or two on the tendencies and limits of modern science, to point out the region which men of science claim as their own, and where it is mere waste of time to oppose their advance, and also to define, if possible, the bourne between this and that other region to which the questionings and yearnings of the scientific intellect are directed in vain.

But here your tolerance will be needed. It was the American Emerson, I think, who said that it is hardly possible to state any truth strongly without apparent injury to some other truth. Under the circumstances, the proper course appears to be to state both truths strongly, and allow each its fair share, in the formation of the resultant conviction. For truth is often of a dual character, taking the form of a magnet with two poles; and many of the differences which agitate the thinking part of mankind are to be traced to the exclusiveness with which different parties affirm one half of the duality in forgetfulness of the other half. But this waiting for the statement of the two sides of a question implies patience. It implies a resolution to suppress indignation if the statement of the one half should clash with our convictions, and not to suffer ourselves to be unduly elated if the half-statement should chime in with our views. It implies a determination to wait calmly for the statement of the whole before we pronounce judgment either in the form of acquiescence or dissent.

This premised, let us enter upon our task. There have been writers who affirmed that the pyramids of Egypt were the productions of nature; and in his early youth Alexander von Humboldt wrote an essay with the express object of refuting this notion. We now regard the pyramids as the work of men's hands, aided probably by machinery of which no record remains. We picture to ourselves the swarming workers toiling at those vast erections, lifting the inert stones, and, guided by the volition, the skill, and possibly at times by the whip of the architect, placing the stones in their proper positions. The blocks in this case were moved by a power external to themselves, and the final form of the pyramid expressed the thought of its human builder.

Let us pass from this illustration of building power to another of a different kind. When a solution of common salt is slowly evaporated, the water which holds the salt in solution disappears, but the salt itself remains behind. At a certain stage of concentration, the salt can no longer retain the liquid form; its particles, or molecules, as they are called, begin to deposit themselves as minute solids, so minute, indeed, as to defy all microscopic power. As evaporation continues solidification goes on, and we finally obtain, through the clustering together of innumerable molecules, a finite mass of salt of a definite form. What is this form? It sometimes seems a mimicry of the architecture of Egypt. We have little pyramids built by the salt, terrace above terrace from base to apex, forming thus a series of steps resembling those up which the Egyptian traveller is dragged by his guides. The human mind is as little disposed to look at these pyramidal salt-crystals without further question as to look at the pyramids of Egypt without inquiring whence they came. How, then, are those salt-pyramids built up?

Guided by analogy, you may suppose that, swarming among the constituent molecules of the salt, there is an invisible population, guided and coerced by some invisible master, and placing the atomic blocks in their positions. This, however, is not the scientific idea, nor do I think your good sense will accept it as a likely one. The scientific idea is that the molecules act upon each other without the intervention of slave labour; that they attract each other and repel each other at certain definite points, and in certain definite directions; and that the pyramidal form is the result of this play of attraction and repulsion. While, then, the blocks of Egypt were laid down by a power external to themselves, these molecular blocks of salt are self-posited, being fixed in their places by the forces with which they act upon each other.

I take common salt as an illustration because it is so familiar to us all; but almost any other substance would answer my purpose equally well. In fact, throughout inorganic nature, we have this formative power, as Fichte would call it—this structural energy ready to come into play, and build the ultimate particles of matter into definite shapes. It is present everywhere. The ice of our winters and of our polar regions is its handiwork, and so equally are the quartz, felspar, and mica of our rocks. Our chalk-beds are for the most part composed of minute shells, which are also the product of structural energy; but behind the shell, as a whole, lies the result of another and more subtle formative act. These shells are built up of little crystals of calc-spar, and to form these the structural force had to deal with the intangible molecules of carbonate of lime. This tendency on the part of matter to organise itself, to grow into shape, to assume definite forms in obedience to the definite action of force, is, as I have said, all-pervading. It is in the ground on which you tread, in the water you drink, in the air you breathe. Incipient life, in fact, manifests itself throughout the whole of what we call inorganic nature.

The forms of minerals resulting from this play of forces are various, and exhibit different degrees of complexity. Men of science avail themselves of all possible means of exploring this molecular architecture. For this purpose they employ in turn as agents of exploration, light, heat, magnetism, electricity, and sound. Polarised light is especially useful and powerful here. A beam of such light, when sent in among the molecules of a crystal, is acted on by them, and from this action we infer with more or less of clearness the manner in which the molecules are arranged. The difference, for example, between the inner structure of a plate of rock-salt and a plate of crystallised sugar or sugar-candy is thus strikingly revealed. These differences may be made to display themselves in phenomena of colour of great splendour, the play of molecular force being so regulated as to remove certain of the coloured constituents of white light, and to leave others with increased intensity behind.

And now let us pass from what we are accustomed to regard as a dead mineral to a living grain of corn. When it is examined by polarised light, chromatic phenomena similar to those noticed in crystals are observed. And why? Because the architecture of the grain resembles in some degree the architecture of the crystal. In the corn the molecules are also set in definite positions, from which they act upon the light. But what has built together the molecules of the corn? I have already said, regarding crystalline architecture, that you may, if you please, consider the atoms and molecules to be placed in position by a power external to themselves. The same hypothesis is open to you now. But, if in the case of crystals you have rejected this notion of an external architect, I think you are bound to reject it now, and to conclude that the molecules of the corn are self-posited by the forces with which they act upon each other. It would be poor philosophy to invoke an external agent in the one case and to reject it in the other.

Instead of cutting our grain into thin slices and subjecting it to the action of polarised light, let us place it in the earth and subject it to a certain degree of warmth. In other words, let the molecules, both of the corn and of the surrounding earth, be kept in a state of agitation; for warmth, as most of you know, is, in the eye of science, tremulous molecular motion. Under these circumstances, the grain and the substances which surround it interact, and a molecular architecture is the result of this interaction. A bud is formed; this bud reaches the surface, where it is exposed to the sun's rays, which are also to be regarded as a kind of vibratory motion. And as the common motion of heat with which the grain and the substances surrounding it were first endowed, enabled the grain and these substances to coalesce, so the specific motion of the sun's rays now enables the green bud to feed upon the carbonic acid and the aqueous vapour of the air, appropriating those constituents of both for which the blade has an elective attraction, and permitting the other constituent to resume its place in the air. Thus forces are active at the root, forces are active in the blade, the matter of the earth and the matter of the atmosphere are drawn towards the plant, and the plant augments in size. We have in succession the bud, the stalk, the ear, the full corn in the ear. For the forces here at play act in a cycle, which is completed by the production of grains similar to that with which the process began.

Now there is nothing in this process which necessarily eludes the power of mind as we know it. An intellect the same kind as our own, would, if only sufficiently expanded, be able to follow the whole process from beginning to end. No entirely new intellectual faculty would be needed for this purpose. The duly expanded mind would see in the process and its consummation an instance of the play of molecular force. It would see every molecule placed in its position by the specific attractions and repulsions exerted between it and other molecules. Nay, given the grain and its environment, an intellect the same in kind as our own, but sufficiently expanded, might trace out *à priori* every step of the process, and by the application of mechanical principles would be able to demonstrate that the cycle of actions must end, as it is seen to end, in the reproduction of forms like that with which the operation began. A similar necessity rules here to that which rules the planets in their circuits round the sun.

You will notice that I am stating my truth strongly, as at the beginning we agreed it should be stated. But I must go still further, and affirm that in the eye of science the animal body is just as much the product of molecular force as the stalk and ear of corn, or as the crystal or salt of sugar. Many of its parts are obviously mechanical. Take the human heart, for example, with its exquisite system of valves, or take the eye or the hand. Animal heat, moreover, is the same in kind as the heat of a fire, being produced by the same chemical process. Animal motion, too, is as directly derived from the food of the animal, as the motion of Trevethyck's walking-engine from the fuel in its furnace. As regards matter, the animal body creates nothing; as regards force, it creates nothing. Which of you by taking thought can add one cubit to his stature? All that has been said regarding the plant may be re-stated with regard to the animal. Every particle that enters into the composition of the muscle, a nerve, or a bone, has been placed in its position by molecular force. And, unless the existence of law in these matters be denied, and the element of caprice introduced, we must conclude that, given the relation of any molecule of the body to its environment, its position in the body might be predicted. Our difficulty is not with the quality of the problem, but with its complexity; and this difficulty might be met by the simple expansion of the faculties which man now possesses. Given this expansion, and given the necessary molecular data, and the chick might be deduced as rigorously and as logically from the egg as the existence of Neptune was deduced from the disturbances of Uranus, or as conical refraction was deduced from the undulatory theory of light.

You see I am not mincing matters, but avowing nakedly what many scientific thinkers more or less distinctly believe. The formation of a crystal, a plant, or an animal, is in their eyes a purely mechanical problem, which differs from the problems of ordinary mechanics in the smallness of the masses and the complexity of the processes involved. Here you have one half of our dual truth; let us now glance at the other half. Associated with this wonderful mechanism of the animal body we have phenomena no less certain than those of physics, but between which and the mechanism we discern no necessary connection. A man, for example, can say I feel, I think, I love; but how does consciousness infuse itself into the problem? The human brain is said to be the organ of thought and feeling; when we are hurt the brain feels it, when we ponder it is the brain that thinks, when our passions or affections are excited it is through the instrumentality of the brain. Let us endeavour to be a little more precise here. I hardly imagine that any profound scientific thinker who has reflected upon the subject exists who would not admit the extreme probability of the hypothesis, that for every fact of consciousness, whether in the domain of sense, of thought, or of emotion, a certain definite molecular condition is set up in the brain; that this relation of physics to consciousness is invariable, so that, given the state of the brain, the corresponding thought or feeling might be inferred; or, given the thought or feeling, the corresponding state of the brain might be inferred. But how inferred? It is at bottom not a case of logical inference at all, but of empirical association. You may reply that many of the inferences of science are of this character; the inference, for example, that an electric current of a given direction will deflect a magnetic needle in a definite way; but the cases differ in this, that the passage from the current to the needle, if not demonstrable, is thinkable, and that we entertain no doubt as to the final mechanical solution of the problem; but the passage from the physics of the brain to the corresponding facts of consciousness is unthinkable. Granted that a definite thought and a definite molecular action in the brain occur simultaneously, we do not possess the intellectual organ, nor, apparently, any rudiment of the organ, which would enable us to pass by a process of reasoning from the one phenomenon to the other. They appear together, but we do not know why. Were our minds and senses so expanded, strengthened, and illuminated as to enable us to see and feel the very molecules of the brain; were we capable of following all their motions, all their groupings, all their electric discharges, if such there be; and were we intimately acquainted with the corresponding states of thought and feeling, we should be as far as ever from the solution of the problem, "How are these physical processes connected with the facts of consciousness?" The chasm between the two classes of phenomena would still remain intellectually impassable. Let the consciousness of love, for example, be associated with a right-handed spiral motion of the molecules of the brain, and the consciousness of hate with a left-handed spiral motion. We should then know when we love that the motion is in one direction, and when we hate that the motion is in the other; but the "WHY?" would still remain unanswered.

In affirming that the growth of the body is mechanical, and that thought, as exercised by us, has its correlative in the physics of the brain, I think the position of the "Materialist" is stated as far as that position is a tenable one. I think the materialist will be able finally to maintain this position against all attacks; but I do not think, as the human mind is at present constituted, that he can pass beyond it. I do not think he is entitled to say that his molecular groupings and his molecular motions explain everything. In reality they explain nothing. The utmost he can affirm is the association of two classes of phenomena of whose real bond of union he is in absolute ignorance. The problem of the connection of body and soul is as insoluble in its modern form as it was in the pre-scientific ages. Phosphorus is known to enter into the composition of the human brain, and a courageous writer has exclaimed, in his trenchant German, "Ohne phosphor kein gedanke." That may or may not be the case; but even if we knew it to be the case, the knowledge would not lighten our darkness. On both sides of the zone here assigned to the materialist he is equally helpless. If you ask him whence is this "matter" of which we have been discoursing, who or what divided it into molecules, who or what impressed upon them this necessity of running into organic forms, he has no answer. Science also is mute in reply to these questions. But if the materialist is confounded, and science rendered dumb, who else is entitled to answer? To whom has the secret been revealed? Let us lower our heads and acknowledge our ignorance, one and all. Perhaps the mystery may resolve itself into knowledge at some future day. The process of things upon this earth has been one of amelioration. It is a long way from the Iguanodon and his contemporaries to the president and members of the British Association. And whether we regard the improvement from the scientific or from the theological point of view as the result of progressive development, or as the result of successive exhibitions of creative energy, neither view entitles us to assume that man's present faculties end the series—that the process of amelioration stops at him. A time may therefore come when this ultra-scientific region by which we are now enfolded may offer itself to terrestrial, if not to human, investigation. Two-thirds of the rays emitted by the sun fail to arouse in the eye the sense of vision. The rays exist, but the visual organ requisite for their translation into light does not exist. And so from this region of darkness and mystery which surrounds us, rays may now be darting which require but the development of the proper intellectual organs to translate them into knowledge as far surpassing ours as ours does that of the wallowing reptiles which once held possession of this planet. Meanwhile the mystery is not without its uses. It certainly may be made a power in the human soul; but it is a power which has feeling, not knowledge, for its base. It may be, and will be, and we hope is turned to account, both in steadying and strengthening the intellect, and in rescuing man from that littleness to which, in the struggle for existence or for precedence in the world, he is continually prone.

Section B.

ADDRESS
TO THE
CHEMICAL SECTION.

August 20, 1868.

By Professor E. FRANKLAND, F.R.S., President.

At these annual reunions of those interested in chemical science it is usual for the president of this section to take a rapid survey of the progress of chemistry during the past year, and in comformity with that custom, it now devolves upon me to bring under your notice some matters which may, perhaps, with advantage arrest our attention for a few moments before we proceed to the actual business of the section.

It may be safely asserted that at no previous meeting of the British Association has there been evinced such an amount of interest in experimental science, and especially in chemistry, as that which pervades the length and breadth of this country. The international display of manufactures last year in Paris produced upon British visitors an impression which, if not quite unanimous in its kind, was almost entirely so, as regards the resulting conviction, viz. that in the education of the youth of this country scientific instruction is neglected, or systematically excluded, to an extent which finds no approach to a parallel in any other great European nation. There are many, and I confess to being one of them, who consider that even now our trade and manufactures are suffering to a very marked extent from this grave defect in our national education. It is thought by some that ignorance on the part of managers and workmen of the scientific truths upon which most manufacturing processes depend has not yet begun palpably to tell upon our manufacturing prosperity; but whatever difference of opinion there may be as to our present industrial position amongst nations, all agree in this, that without the extensive introduction of thorough scientific training into the education of those destined for industrial pursuits, we can no longer continue to maintain that pre-eminence in manufactures which we have now so long enjoyed.

The great science schools of the continent have no parallels in this country. The discouraging way in which scientific studies are being introduced into our older universities, the lack of the necessary funds for the proper endowment of professorships and for the provision of suitable buildings and apparatus in our modern institutions, and the insignificance of the rewards offered to successful students in science, have naturally operated most injuriously upon the extension of chemical culture. Whilst in Heidelberg, Zürich, Bonn, Berlin, Leipzig, and Carlsruhe magnificent edifices have been raised, replete with all the newest contrivances for facilitating the prosecution of chemical studies, we are here still compelled to give instruction and conduct research in small and inconvenient buildings utterly inadeqnate to the requirements of modern chemistry. The large sums spent by the governments of Germany and Switzerland upon these establishments sufficiently testify to their opinion of the national value of chemistry in education. The laboratory at Zürich cost £14,000, that of Bonn £18,450, the one now nearly completed in Leipzig will cost £12,120, whilst the estimates for the Berlin laboratory, with its seventy-four rooms, amount to no less than £47,715.

Such being the comparatively discouraging circumstances under which chemistry is prosecuted in this country, it is not surprising that neither the number of investigators, nor the amount of new facts added to our knowledge during a given time will bear a favourable comparison with the chemical activity of other and more favoured nations. In 1866, 1273 papers were published by 805 chemists, being at the average rate of 1·58 paper for each investigator. Of these, Germany contributed 445 authors and 777 papers, or 1·75 paper to each author; France 170 authors and 245 papers, or 1·44 paper to each author; the United Kingdom 97 authors and 127 papers, or 1·31 paper to each author; whilst other countries furnished 93 authors and 124 papers, or 1·33 paper to each author. Our case is even worse than it appears to be from these figures; for a considerable proportion of the papers contributed by the United Kingdom were the work of chemists born and educated in Germany, but resident in this country. I am not aware how far a like comparison as regards activity in research obtains in other sciences; but if the United Kingdom takes a similar position in them, it is nothing less than a national disgrace that a country which perhaps more than any other owes its greatness to the discoveries of science should do so little towards the extension of scientific research.

Fortunately, however, this national apathy has not been shared by individual chemists, and the year has not passed without several important additions to our knowledge. The Master of the Mint has continued his remarkable researches on the occlusion of gases by metals. The extraordinary property possessed by some of the metals, but especially by palladium, of absorbing large volumes of certain gases, is one of the most interesting of modern observations, and can scarcely fail to throw light upon that obscure class of phenomena occupying the border land between the recognised domains of chemical and cohesive attraction.

Many cosmical changes, such as the variation of animal and vegetable species, move too slowly for our study. On the other hand, the sequence of transformations in chemical phenomena has generally been deemed too rapid to permit of the observation of anything but the final result. Harcourt and Esson, however, have shown that this phase of chemical action can be studied with very interesting results; in the cases of the action of oxalic acid upon permanganic acid, and of hydriodic acid upon hydroxyl, they have arrived at the following important conclusions:—

1. The rate at which a chemical change proceeds is constant under constant conditions, and independent of the time that has elapsed since the change commenced.

2. When any substance is undergoing a chemical change, of which no condition varies excepting the diminution of the changing substance, the amount of change occurring at any moment is directly proportional to the quantity of the substance.

3. When two or more substances act one upon another the amount of action at any moment is directly proportional to the quantity of each of the substances.

4. When the rate of any chemical change is affected by the presence of a substance which itself takes no part in the change the acceleration or retardation produced is directly proportional to the quantity of the substance.

5. The relation between the rate of a chemical change occurring in a solution and the temperature of the solution is such that, for every additional degree, the number expressing the rate is to be multiplied by a constant quantity.

In mineral chemistry an active member of this section has done excellent service by the careful re-investigation of the compounds of vanadium. Roscoe's researches have led to the discovery that vanadium does not, as was previously believed, belong to the sulphur group of elements, but to the nitrogen group. The vanadic chloride, of anomalous vapour-density, is now shown to be a normal oxychloride. The isolation of vanadium will be looked forward to with much interest, since the atomic weight of this element assigns to it a position intermediate between phosphorus and arsenic.

Chemists had long regarded with regret the labour expended by meteorologists on observations made with the intention of estimating ozone in the atmosphere, in the absence of any conclusive evidence of the existence of this substance in the air. It is therefore highly satisfactory that Andrews, to whom we were already so much indebted for our knowledge of the properties of ozone, has at length proved that the reaction exhibited by ozone test-papers at a distance from towns is in reality due to ozone. Thus the numerous observations, extending over so many years, now attain a value which they did not before possess.

The synthetical and constitutional departments of organic chemistry have received important additions from the discoverer of the first aniline colour. In pursuing his interesting researches on the salicylic series, Perkin has succeeded in artificially producing coumarin—the odoriferous principle of the sweet-scented woodruff and tonquin bean—besides a number of homologues of this substance. To the same chemist we are also indebted for a theoretical paper of great importance, on the probable difference in the value of the four bonds of carbon—a subject which, in its bearings upon isomerism, has long claimed, though it has never received, the earnest attention of chemists.

Perkin and Duppa have submitted the glyoxylic acid, originally obtained by them from dibromacetic acid, to a searching constitutional investigation, which has led them to the conclusion that this acid is identical with the one obtained by Debus from the slow oxidation of alcohol; thus establishing the fact that two semi-molecules of hydroxyl can unite with one and the same atom of carbon—a kind of combination the possibility of which had been disputed, although an analogous compound of hydrosulphyl is well known.

Maxwell Simpson, another of the most active and successful workers in this branch of organic chemistry, has continued his researches on the constitution of succinic acid, and on the direct transformation of chloriodide of ethylene into glycol.

To general organic chemistry important contributions have been made by Stenhouse on chloranil, and by Griess on the action of cyanogen upon amido-acids.

Physiological chemistry has received a new impulse from the highly instructive experiments of Crum Brown, and Fraser, on the connection between chemical constitution and physiological action. It had been shown by Bunsen that cacodylic acid, though readily soluble, and containing 54 per cent of arsenic, produced, when administered to animals, no appreciable poisonous effect, whilst Landolt found that the poisonous properties of antimony disappeared in the salts of tertramethylstibonium. Messrs. Crum Brown and Fraser have studied the change in physiological action produced by the addition of methylic iodide to the natural alkaloids, strychnine, brucine, thebaine, codeine, morphine, and nicotine, and they show conclusively that the physiological action of these poisons is both greatly diminished in degree and completely changed in character. Their experiments also lead them to the singularly remarkable and important conclusion, that when a nitrile base possesses a strychnine-like action, the salts of the corresponding ammonium bases have an action identical with that of the curare poison. It is well known that curare and strychnine are derived from plants belonging to the same *genus*; and it is, therefore, interesting to observe such a relationship.

Again, the experiments of Dr. Arthur Gamgee on the action of carbonic oxide upon blood afford a striking illustration of the successful application of the most delicate processes of chemical analysis to physiological research.

I cannot close this brief and very imperfect summary of British chemical investigation during the past year without congratulating the section on the completion of that most valuable addition to the literature of the science—Watts's "Dictionary of Chemistry." The extent, completeness, unity of design, and general accuracy of this great work reflect the highest credit upon its talented editor, who has conferred a boon upon his colleagues for which they can never sufficiently thank him.

The statistics illustrative of comparative chemical activity in this country and elsewhere warn me not to attempt, in these necessarily brief remarks, any analysis of foreign research. I cannot, however, avoid alluding to one or two out of the many foreign achievements of the past year.

In mineral chemistry, the application of the doctrines of atomicity to the formulation of natural minerals, in the new edition of Dana's great work, constitutes an epoch in mineralogy which can scarcely fail to produce in that science results as important as those which this doctrine has already achieved in chemistry proper.

In organic chemistry, Hofmann's discovery of a new series of cyanogen compounds imparts a new stimulus to researches on isomerism, and will long remain one of the great landmarks in organic research.

In Kolbe's laboratory the yearly harvest of synthetical discoveries has not failed. The direct conversion of carbonic anhydride into oxalic acid by Dr. Drechsel, and of ammonic carbonate into urea by Basaroff, are amongst the most brilliant achievements yet recorded in this branch of research.

The artificial production of neurine by Wurtz illustrates strikingly the precision with which the results of chemical action can now be predicted. The atomic theory of Dalton, developed as it has been by the doctrine of atomicity, is rapidly assuming for chemical phenomena the position which the theory of gravitation occupies in cosmical science.

After a long period of indecision and confusion, as regards the atomic weights of a majority of the elements, it is gratifying to find that, at the present moment, an almost complete unanimity prevails amongst chemical teachers. Out of upwards of 900 papers, worked in all parts of the United Kingdom, at a recent examination connected with the Science and Art Department, the old atomic weights were employed in less than twenty cases. It is much to be regretted that this unanimity does not extend to notation and nomenclature; as regards the latter, a much greater uniformity prevails in France and Germany than in this country, and it is greatly to be desired that efforts should be made to bring about a better understanding on this subject. To the student a uniformly recognised nomenclature is perhaps of more importance than a generally accepted notation. For the present, the realisation of the latter appears to be impossible; but by a little mutual concession on the part of teachers, and especially of authors, there would be good hope of soon accomplishing the former.

ON CHLORIDE OF METHYLENE PREPARED FROM CHLOROFORM

BY MEANS OF

NASCENT HYDROGEN,[*]

By W. H. PERKIN, F.R.S.

FROM the history of monocarbon derivatives as it stands at present it would appear that there exist several bodies isomeric with each other. Thus we have the description of two bromides of methyl, the one liquid and the other gaseous;[†] two chlorides of methylene, the one boiling at 30·5° C.,[‡] the other at about 40° C.;[||] two sulphur methylic acids, the one forming a hydrated barium salt, crystallising in four-sided tables, the other forming a similar salt, but anhydrous and crystallising in very long thin prisms.[§] But, although these bodies have been described by men of great eminence, yet it is considered by some chemists that this isomerism is improbable, and that these substances, if re-examined by the more accurate methods of the present day, would be found to be identical.

There can be no doubt that this question is one of very considerable importance, because, if isomerisms exist in the monocarbon series, in all probability it will be found also to exist in the derivatives of all other polyatomic elements.

These considerations have induced me to commence a fresh examination of some of the monocarbon derivatives, hoping that an experimental comparison of their properties may in some degree help to the solution of this problem.

In this communication I shall only give a short account of some experiments upon the chloride of methylene obtained from chloroform by the action of nascent hydrogen. Dr. Richardson has already mentioned that this product may be produced in this manner, but has only studied its properties physically and as an anæsthetic.

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[*] British Association, Norwich Meeting, Section B.

[†] Bunsen.

[‡] Regnault.

[||] Butlerow.

[§] Dumas and Peligot.

The method I have employed for the preparation of this body results from the examination of a reaction pointed out to me by my friend Mr. J. Williams. He observed that powdered zinc, when brought in contact with chloroform and ammonia, or even tetrachloride of carbon, reacted with great energy, the mixture entering into violent ebullition. So far as I have studied this reaction, the principal products formed are—chloride of methylene and marsh gas; but little, if any, chloride of methyl being produced.

In preparing the chloride of methylene by this process I have generally used an alcoholic solution of chloroform, with an excess of powdered zinc, and but little ammonia. The experiment was performed in a flask connected with an inverted Liebig's condenser. On mixing the reagents, the temperature gradually rises, and the mixture soon enters into ebullition, marsh gas at the same time passing away; after the reaction has ceased, the products are digested and then distilled off. The addition of water to this distillate causes an oil, consisting of chloroform and chloride of methylene, to separate; this, when dried and subjected to fractional distillation, gives a body boiling at about 40° to 42°. To remove any traces of alcohol that it may still be contaminated with, it is agitated with a small quantity of sulphuric acid, separated, and again distilled. The following combustions were made of two different quantities, the first boiling at 42° C., and the second at 40·5° to 41° C.:—

I.

·1956 of substance gave
·1013 of CO_2 and
·0446 of H_2O.

II.

·2401 of substance gave
·1221 of CO_2 and
·0509 of H_2O.

These numbers give percentages agreeing with the formula CH_2Cl_2, as the following comparisons will show:—

	Theory.		Experiment.	
			I.	II.
C	12	14·117	14·12	13·86
H_2	2	2·352	2·53	2·35
Cl_2	71	83·531	—	—
	85	100·000		

This formula was controlled by two Guy Lussac vapour densities.

Theory.	Experiment.	
	I.	II.
2·941	2·992	3·012

Chloride of methylene obtained in this manner possesses the same boiling point (or nearly so) as that obtained by Butlerow from the chloride prepared from the iodide of methylene from iodoform. By description, it would therefore appear to differ from Regnault's chloride of methylene, or chlorinated chloride of methyl, which is said to boil at 30·5°, and, moreover, it appears to be acted upon by alcoholic hydrate of potassium more readily than that body; but, before asserting this to be a fact, I hope to compare these substances, and am at present occupied in preparing a quantity of Regnault's product. Chloride of methylene is but little acted upon with sodium.

I hope to examine the reactions and products of decomposition of this body so soon as I have sufficient material to work with; unfortunately, the above process does not yield it in large quantities.

Tetrachloride of carbon, when treated with powdered zinc and ammonia, yields a body which is apparently ordinary chloroform, and also marsh gas. I have not, however, examined this reaction sufficiently to state what are the true products.

MISCELLANEOUS.

British Association for the Advancement of Science (Norwich Meeting).—The following is a complete list of the papers which were brought before Section B (Chemical Science):—

W. H. Perkin, F.R.S.—*On the Chloride of Methylene formed by the Action of Nascent Hydrogen on Chloroform.*
Dr. T. L. Phipson—*On Sulphocyanide of Ammonium.*
Dr. J. H. Gladstone—*Refraction Equivalents and Chemical Theories.*
C. Tomlinson, F.R.S.—*On the Action of Nuclei in Inducing Crystallisation.*
F. A. Abel, F.R.S.—*On the Chemical Composition of the great Cannon of Mohammed II., recently presented by the Sultan Aziz Khan to the British Government.*
John Spiller, F.C.S.—*Analysis of the Ancient Roman Mortar of the Castrum of Burgh, Suffolk.*
Alfred R. Catton—*Report of Synthetical Researches on Organic Acids.*
A. Matthiessen—*Report on the Chemical Nature of Cast Iron.*
A. Matthiessen and W. J. Russell—*Note on the Vesicular Structure of Copper.*
E. Frankland—*On the Combustion of Gases under Pressure.*
W. Perkin—*On the Preparation of Anhydrous Salts of some Organic Compounds.*
— Meusel—*On Paraffin and its Products of Oxidation.*
Alfred R. Catton—*Note on Löwig's Researches on the Action of Sodium Amalgam on Oxalic Ether.*
C. W. Siemens—*On Puddling Iron.*
Otto Richter—*On a System of Chemical Philosophy.*
T. Wood—*On Chemistry as a Branch of Education.*
E. Meusel and C. H. Gill—*On Paraffin and its Products of Oxidation.*
E. Meusel—*On the Physical Properties of Two Coloured Compounds.*
A. R. Catton—*Note on Löwig's Researches on the Action of Sodium Amalgam on Oxalic Ether.*
Angus Smith—*On the Absorption of Gases by Charcoal.*
J. Dewar—*On Coal-Tar Bases.*
T. Fairley—*Report on the Polyatomic Cyanides.*
J. Dewar—*On Kekule's Model to Illustrate Graphic Formulæ.*
W. Dittmar—*On Vapour Tensions.*
Ludwig Mond—*On the Manufacture of Sulphur from Alkali Waste in Great Britain.*
R. Gerstl—*Different Spectra of one Chromium Salt.*
J. A. Wanklyn—*A Note on Sea Water.*
J. A. Wanklyn—*Researches on the Ethers.*
F. Guthrie—*On Amyl-ethyl-methyl Acetonamine.*
A. R. Catton—*On Mitscherlich's Law of Isomorphism and on the so-called cases of Dimorphism.*

Place of Meeting for Next Year.—It has been decided to hold the next meeting at Exeter, under the presidency of Professor G. G. Stokes, Sec. R.S.

The Treatment and Utilisation of Sewage.—A recommendation forwarded to Section B of the British Association was read by the President, and was to the effect that impartial reports should be made and communicated to the Association on the treatment and utilisation of sewage in connection with the drainage of towns, in order that such facts and information as may guide future operations may be recorded from time to time. It was therefore proposed that some member of the Committee out of the three following sections should be appointed a committee to draw up the report:—Section B—J. H. Gilbert, F.R.S., F.C.S.; Section F—W. D. Harding, C.E.; Section G—Richard B. Grantham, C.E., F.G.S., with power to add to their number; and that a sum of £30 be granted for the payment of such expenses as are incurred in the course of the investigations. The committee should be requested to include in the details of each report—

1st. The special circumstances of each case, such as the extent of district, the population, and the number of houses with or without the benefit of drainage.

2nd. The character of the sewage and water supply adopted in the district, and the quantity of sewage at disposal.

3rd. The mode of disposing of the sewage, with description of the works and their cost.

4th. The result pecuniarily to the district and to those who are selling or applying the sewage to the land, or otherwise, in any form whatever.

The Alkaline Deposits of Western America.—The correspondent of the *Chicago Tribune* writes as follows of the country west of Laramie, on the Pacific Railroad:—" From Laramie to here the country is very miserable and very curious. Here and there a patch of buffalo grass may be seen, but rarely anything except sage brush and cactus. The ground seems incapable of producing anything else. The banks of all the small streams glisten with white where the alkali has been evaporated. Almost all the small streams here are impregnated with this alkali. It renders the water almost useless for all practical purposes, but it produces some very queer effects, as the workmen on the road and the visitors can testify. If one drinks much of it, the same effect is produced as if a strong dose of salts is taken. This greatly digusted the workmen when they were forced to drink it. Nor can the water be used in the engines with any effect; the steam it makes has no power. The water expends itself in froth and suds, and it eats and corrodes the boiler. This has been a great source of annoyance, and is one of the worst obstacles that the road has to overcome. Another peculiarity of this water is the effect it produces on the skin of those who wash in it; it roughens the skin of the hands just as a cold wind chaps it in winter. It also peels the skin from the face, so that a person who uses this water has a new skin about every seven days. This is especially the case where soap is used in washing. The graders west of here, where the alkali in the water is much stronger, say that when soap is wanted for washing clothes, &c., they put some grease in the alkali water, stir it up with a stick, and there is soap. Naturally it costs but little, and when freights are reduced on the road it is proposed to supply the whole United States with cheap and good soap. Unfortunately there is no demand for that article among the Indians, and the Great Western Soap Factory cannot be started at present. As it is, every man is his own soap-maker, The result of this bad water has been to force the railroad company to dig deep wells along the line of this road. But even this is not always satisfactory; the well at Wyoming, fifteen miles west of Laramie, is almost useless on account of the alkali. In some places along the road the country is almost completely covered with the low thick sage brush, useless for anything, except in some places where the wood is so large that it can be burned. In this region, where the land happens to be free from the sage brush, it is often so impregnated with the alkali that for two or three inches down the earth crumbles and sinks beneath the feet like ashes. Every now and then there are found in this region drifts of fossils of fish, oysters, clams, &c., thrown up from the bottom of the sea quite a time ago. Some of these fish are so well preserved that the glitter of the gold and silver on their scales is almost as bright as ever. The oysters and clams are tremendous in size, and would well do for the giants of the olden days. Some of the snakes are quite large in size, but few of them are perfect. Some of them are found embedded in red sandstone, while others lie loose in the earth. Along with these are to be found many sea shells of various kinds. In some cases the fish will be found split open, and all the bones perfectly preserved. Some of these drifts are on the tops of bluffs, while others are low down.

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2405. J. F. Lackersteen, Cannon Street, London, " Improvements in means or apparatus for the preservation of organic substances."

2417. J. Heaton, Langley Mills, Derbyshire, " Improvements in the treatment of cast iron."—Petition recorded July 31, 1868.

2439. W. Spence, Quality Court, Middlesex, " Improvements in the treatment of auriferous, argentiferous, and other ores."—A communication from L. E. Rivot, Paris.

2441. H. A. Bonneville, Chaussée d'Antin, Paris, " Improvements in the process of dyeing textile materials, and in the apparatus connected therewith."—A communication from C. Corron, St. Etienne, France.—August 4, 1868.

2451. J. Hamilton, Chancery Lane, " Improvements in the manufacture of artificial fuel."

2453. A. V. Newton, Chancery Lane, " Improvements in the manufacture of iron and steel."—A communication from L. Sibert, Mount Solon; D. C. E. Brady, Buffalo Lodge; J. D. Imboden and S. M. Barton, Richmond, Virginia, U.S.A.—August 5, 1868.

2461. J. Hargreaves, Darlington, Durham, " Improvements in the manufacture of steel and iron, and in the preparation of materials and agents, and in apparatus to be employed therein."—August 6, 1868.

NOTICES TO PROCEED.

1167. A. L. Holley, Harrisburgh, U.S.A., " Improvements in the manufacture of iron and steel."—Petition recorded April 7, 1868.

1181. J. James, Ebbwvale, Monmouthshire, and T. Jones, Govilon, Monmouthshire, " Improvements in the manufacture of iron into semi-steel or steel."—April 8, 1868.

1422. J. H. Johnson, Lincoln's Inn Fields, Middlesex, " Improvements in the manufacture of gelatine."—A communication from F. Coignet, Paris.—April 30, 1868.

1480. T. Warren, Glasgow, N.B., " Improvements in glass and other furnaces."

1489. M. Henry, Fleet Street, London, " Improvements in the manufacture of steel and iron, and other metals, and in furnaces employed in the said manufacture."—A communication from the Société Coignet et Compagnie, Boulevart St. Martin, Paris.—May 6, 1868.

1954. W. C. Sillar, Cornhill, London, R. G. Sillar, Upper Norwood, and G. W. Wigner, Camberwell, Surrey, " Improvements in deodorising and purifying sewage, and making manure therefrom."—June 15, 1868.

2440. H. A. Bonneville, Chausée d'Antin, Paris, " A new and improved process of preserving meat, and the apparatus connected therewith."—A communication from W. Wiesmann, Bonn, Prussia."—August 4, 1868.

NOTES AND QUERIES.

Phosphate of Alumina in solution may be decomposed by adding bichloride of tin, boiling, and precipitating all the oxide of tin in combination with phosphoric acid, by means of sulphate of soda. The accuracy of this method has not yet been fully established. If sesquioxide of iron is also present in the liquid a certain quantity will be precipitated at the same time.—F. Wohler.

A Question in Agricultural Chemistry.—Some few years ago one or two landowners who had some wet, peaty land, formed into a committee, and drained it at a considerable cost. Their anticipations were very great, as, owing to the great quantity of humus, a continuation of good crops was expected; but, alas! to their dismay and cost, after the second and third seasons, they couuld not get a crop anything near the average—nay, there was not even sufficient grass to pay the expense of cutting it. Now, Sir, I would ask why there is such an exhaustion, and what are the elements most likely to be exhausted? Ammonia, nitrogen, phosphates, &c.?—Agricultural Novice in Chemistry.

TO CORRESPONDENTS.

Alpha.—No English book has been published on the subject.

J. Hardman.—The best information on the subject is probably to be found in Knapp's " Technology," by Richardson and Watts.

J. Reddrop.—A new edition of the work in question is in preparation, and will be published in the course of a few months. It will be in the New Notation.

W. James.—A warm aqueous solution of oxalic acid will immediately decompose phosphate of lime. Perhaps this reaction may be of use to you.

Olinthus.—Nickel is produced in large quantities at Birmingham. The exact details of its manufacture are kept secret, but it is by a wet process in which the property of carbonate of lime to precipitate metallic oxides is made use of to purify the metal from iron, arsenic, and copper. By regulating the temperature and precipitating fractionally, it is possible to remove all these metals from the solution, leaving the nearly pure nickel behind.

THE CHEMICAL NEWS.
Vol. XVIII. No. 457.

ON SULPHOCYANIDE OF AMMONIUM.*

By Dr. T. L. PHIPSON, F.C.S., &c.

This is a salt which can be obtained in large quantities from the products of the distillation of coal. It accompanies the other compounds of ammonia in the ammoniacal liquor of gas-works.

In several works it is made to yield its ammonia for the production of sulphate of ammonia; for this purpose it is distilled with lime after the carbonate and sulphide of ammonium have been distilled.

For many years I have noticed that the sulphate of ammonia supplied to commerce for agricultural and other purposes often contains a small quantity of sulphocyanide, say from 2 to 4 per cent, but latterly a much larger quantity, which increases its yield in nitrogen when submitted to analysis without bestowing upon the product a corresponding value in an agricultural sense. For though the nitrogen of the ammonium in the sulphocyanide can be utilised like that in sulphate of ammonia, that contained in the form of sulphocyanogen escapes. In other terms only one half of the nitrogen in sulphocyanide of ammonium is available in the manufacture of artificial manures, since the other half is partly volatilised as sulphocyanhydric acid, and partly decomposed by the heat of the reaction, which is sometimes great enough to ignite the bisulphide of carbon resulting from the decomposition.

Within the last twelve months the quantity of sulphocyanide of ammonium present in some kinds of commercial sulphate of ammonia appears to have increased considerably, and several samples which I have examined recently have yielded upwards of 75 per cent of this salt; in fact, they were not sulphate of ammonia at all, but impure sulphocyanide of ammonium.

I found it necessary some time ago to discover a means of estimating rapidly and with accuracy the amount of this product when mixed with sulphate and chloride of ammonium and the various organic matters which usually accompany the commercial products.

Sulphocyanide of ammonium can be separated with tolerable accuracy from the sulphate by means of alcohol, in which it is freely soluble; but this method will not apply when chloride of ammonium is present also, nor does it give the sulphocyanide in a convenient form for weighing.

A method which I have satisfied myself gives very accurate results and is sufficiently rapid, consists in dissolving a given weight of the product in water, filtering, rendering the solution rather acid, and precipitating the sulphocyanogen as an insoluble salt of copper by the addition of equal equivalents of sulphate of protoxide of iron and sulphate of copper. The whole of the sulphocyanogen is eliminated in this manner. The copper compound is received upon a weighed filter, dried at 100° C., and weighed. It is anhydrous, and contains 2 equivalents of copper, 2 of carbon, 2 of sulphur, and 1 of nitrogen,—$Cu_2C_2NS_2$.

Having prepared a certain quantity of pure sulphocyanide of ammonium, I took the opportunity of studying some of its properties. Of these experiments I will mention only those which appear not to have been made before.

Sulphocyanide of ammonium dissolves copiously in water and in alcohol, and these solutions offer considerable interest. In the first place, in dissolving rapidly in water this salt produces a greater degree of cold than any other compound with which I am acquainted. About half a litre of hot water being poured upon 500 grammes of the impure salt, I was surprised, on stirring the whole together, to find that hoar frost appeared immediately on the external surface of the vessel. The temperature of the solution was found to be between 2 and 3 degrees below zero, that of the hot water used 96°, showing that the temperature had sunk 98° or 99° C., in the space of a few seconds.

A substance which absorbs so much heat whilst dissolving would be expected to give out again much caloric when it crystallises, and such is the case. With saturated solutions the crystallisation is accompanied on this account with some curious phenomena. As one large crystal forms the adjacent crystals are dissolved again by the heat produced, giving rise to a series of rapid movements in the liquid and along its surface. Some of these vibrations spread along the entire surface with the rapidity of lightning, and continue at short intervals until the whole liquid suddenly solidifies.

From concentrated solutions sulphocyanide of ammonium crystallises in large transparent plates of a slightly pearly aspect. These plates appear to be formed of long prismatic needles intimately united, and are best obtained with very concentrated solutions. When weaker solutions are caused to crystallise, right rectangular prisms are formed: they are often of great length; I have occasionally obtained them 2 or 3 inches long.

The alcoholic solution of sulphocyanide of ammonium presents in the highest degree the peculiar phenomena of *supersaturation*. A saturated hot solution after cooling will remain liquid for hours, probably for days together. But if the liquid is stirred with a glass rod it is immediately transformed into a mass of small crystalline plates. When, instead of a glass rod, a minute crystal of the salt itself is thrown into the supersaturated solution after it has become quite cold, at the same instant magnificent rectangular plates, having the four faces of the octahedron, begin to form rapidly upon the surface, and the vessel is soon filled with splendid crystals. The supernatant liquid separated from these can be made to deposit still a considerable quantity of small crystalline plates by being stirred rapidly for a minute or two with a glass rod.

A concentrated aqueous solution of sulphocyanide of ammonium has no action upon sulphur; but it dissolves a considerable quantity of iodine, and when the dark-coloured solution is diluted and heated, the yellow compound called "sulphocyanogen," is precipitated, and the liquid becomes colourless. Bromine acts in a similar manner. Each drop of bromine on falling into the warm solution produces a hissing noise; on boiling the liquid the sulphocyanogen compound is precipitated. These two precipitates are insoluble in alcohol and soluble in sulphuric acid like that which is produced by chlorine.

The action of chlorine gas upon solutions of sulphocyanide of ammonium is very remarkable. If the solution is dilute the sulphur is gradually oxidised to sulphuric acid, and no precipitate is formed. If concentrated, a dense precipitate of sulphocyanogen occurs after a little while. It is difficult to obtain the whole of the cyanogen in this form, even when the liquid is kept near its boiling point the whole time. When the decomposition is complete and the liquid separated from the precipitate is evaporated, it yields chloride of ammonium. The action of chlorine on this solution is yet incompletely known. The composition of the so-called "sulphocyanogen" has been much discussed. For some time this precipitate was considered to be the radical of sulphocyanhydric acid, but it was afterwards found to contain hydrogen and oxygen. The composition assigned to this substance by Laurent and Gerhardt, namely 3 equivalents of cyanogen, 1 of hydrogen, and 6 of sulphur, appears to be inadmissible. The results of my analysis of this compound correspond with those of Vœlkel, not with those of Laurent and Gerhardt. It should be stated, however, that Charles Gerhardt, to whom organic chemistry owes so many splendid investigations, whilst criticising Herr Vœlkel's labours on sulphocyanogen, based his own opinion in this case upon an incomplete analysis of the substance in question. The product can be completely purified by washing with hot water and with alcohol should it contain any persulphocyanhydric acid, which seldom occurs, or when it does happen to be present is generally in too small a quantity to affect the results of the analysis. The dried precipitate is anhydrous. It has yielded—

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* British Association, Norwich Meeting, Section B.

	T. L. P.	Vœlkel.	Calculated.
C	20·00	19·93	19·83
H	0·78	1·08	0·82
N	23·20	23·31	23·14
S	53·00	52·68	52·48
O	3·02	3·00	3·73
	100·00	100·00	100·00

This composition corresponds with the formula $C_8H_2N_4S_8O$, admitted by Herr Vœlkel, and not with that of Gerbardt, which requires 24 per cent of nitrogen and nearly 55 of sulphur; it contains the elements of 4 equivalents of sulphocyanogen, 2 of hydrogen, and 1 of oxygen.—

$$\left.\begin{matrix} 4C_2NS_2 \\ 2H \\ O \end{matrix}\right\} = C_8H_2N_4S_8O.$$

The insoluble copper salt above mentioned was suspended in boiling water, whilst a current of chlorine gas was passed through the solution, with the expectation of obtaining sulphocyanogen itself, but little or no decomposition ensued; when iodine was substituted for chlorine the copper compound was partially decomposed, with production of some iodide of copper and an odour of iodide of cyanogen.

In conclusion, I may add that as the products derived from sulphocyanide of ammonium are very numerous, it is not impossible that some of them may eventually be applied to some useful purpose; if so it will be satisfactory to know that we possess a supply of this salt as inexhaustible as that of coal itself.

NOTE ON THE
PREPARATION OF SOME ANHYDROUS SODIUM DERIVATIVES OF THE SALICYLIC SERIES.*

By W. H. PERKIN, F.R.S.

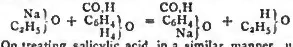
In the preparation of salts or other metallic derivatives of organic bodies by means of oxides, there is always an equivalent of water produced, unless the substance acted upon be an anhydride; therefore, if the resulting compound has any tendency to form hydrated products, such are nearly sure to be produced, and it often happens that it is difficult or impossible to remove this combined water. Having to prepare a quantity of hydride of sodium—salicyl (salicylate of sodium) in an anhydrous state, it appeared to me that if I could obtain it anhydrous at once that I should avoid that blackening and loss which this salt is subjected to unless dried very rapidly.

I first thought of dissolving sodium in the anhydride; but such a process is unmanageable, and could not yield a pure product.

It then appeared to me if I could work with absolute alcohol in place of water, that I might obtain this result, but then what was to be substituted for the metallic oxide? Sodium-alcohol was proposed, as it would yield only an equivalent of alcohol when decomposed, instead of an equivalent of water; with this product I succeeded perfectly.

To prepare the anhydrous hydride of sodium-salicyl, it is only necessary to dissolve a weighed quantity of sodium in about twenty or thirty times its weight of alcohol, and then to add the theoretical amount of hydride of salicyl, also mixed with alcohol. If these solutions are added hot the mixture will enter into ebullition, and beautiful golden scales of the new product crystallise out. After standing for about half an hour the new salt is filtered off, washed once or twice with alcohol, pressed between bibulous paper, and placed in the water oven, where it will be found to dry in a comparatively short time. Thus obtained the hydride of sodium-salicyl is of a beautiful primrose yellow colour. Sodium determinations of this product gave numbers showing it to be perfectly pure.

The reaction by whicb it is formed may be thus expressed:—

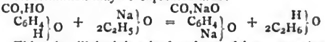


$$\left.\begin{matrix} Na \\ C_2H_5 \end{matrix}\right\}O + \left.\begin{matrix} CO,H \\ C_6H_4 \\ H_4 \end{matrix}\right\}O = \left.\begin{matrix} CO,H \\ C_6H_4 \\ Na \end{matrix}\right\}O + \left.\begin{matrix} H \\ C_2H_5 \end{matrix}\right\}O$$

On treating salicylic acid in a similar manner, using 2 equivalents of sodium to 1 equivalent of acid, a beautiful white salt, crystallising in needles is obtained. This when dried and analysed was found to be a di-sodium derivative—salicylic acid with both its acid and phenolic hydrogen replaced by sodium—it therefore corresponds to that series of salts obtained by Piria, and which led chemists to believe salicylic acid to be bibasic.

This salt is deliquescent and possesses a very alkaline reaction; it is very soluble in water.

Its formation may be expressed thus:—



$$\left.\begin{matrix} CO,HO \\ C_6H_4 \\ H \end{matrix}\right\}O + \left.\begin{matrix} Na \\ 2C_2H_5 \end{matrix}\right\}O = \left.\begin{matrix} CO,NaO \\ C_6H_4 \\ Na \end{matrix}\right\}O + \left.\begin{matrix} H \\ 2C_2H_6 \end{matrix}\right\}O$$

This salt will doubtless be found a useful reagent when it is desired to substitute both these replaceable hydrogens of salicylic acid by radicals.

The corresponding potassium derivative prepared with potassium alcohol is not so easy to obtain as the sodium one, owing to its easy solubility in alcohol.

I have also obtained a very peculiar sodium derivative of *salicin* by treating it with an alcoholic solution of sodium alcohol.

When these bodies are mixed together and stirred the salicin dissolves, but after the lapse of a sbort time a slightly crystalline powder forms and soon renders the mixture quite pasty. On washing this product with alcohol and then drying it gently in the water-oven, it is obtained as a white, rather friable mass. Analysis of this body has shown it to consist of salicin with an equivalent of hydrogen replaced by sodium:—

$$C_{13}H_{17}NaO_7.$$

Although I have experimented with an excess of sodium alcohol, yet I have not been able to introduce a further quantity of sodium into salicin.

I have made similar experiments with gallic acid, but although the product always contained a very great deal more sodium than a normal gallate, yet I have not been able to obtain a definite product. This would appear to result from the insolubility of the salt in alcohol, as it is precipitated before the solutions can be well mixed, and is therefore not homogeneous in composition. It is possible that potassium alcohol would yield a better result.

ON THE ACTION OF NUCLEI IN INDUCING CRYSTALLISATION.*

By CHARLES TOMLINSON, F.R.S.

In introducing this subject to the Chemical Section of the British Association, Mr. Tomlinson stated that it formed the subject of a note sent in to the Royal Society, as an addendum to his paper read before that body on the 28th May last, on "Supersaturated Saline Solutions."†

On that occasion it was noticed by one of the Fellows that some tubes, containing supersaturated solutions, exhibited by Mr. Tomlinson, had a saline crust just above the liquid surface, arising from a portion of the water of the solution evaporating through the cotton wool with which the tubes were plugged. It was stated that this saline crust did not act as a nucleus to the remainder of the solution, because, according to Mr. Tomlinson's theory, it was chemically clean. The objection raised was, that in cases of ordinary crystallisation, as in nursing a crystal of alum for example, we must be dealing with chemically clean surfaces during the growth of the crystal. The answer to this objection is that in the case referred to none of the conditions of chemical purity are observed; the evaporating dish is not chemically clean, nor is the solution exposed to the air, nor is the hair by which the crystal is suspended, nor is the crystal, for this is frequently taken out and exposed to the air, and abnormal growths are chipped off with the thumb-nail. If all the conditions of chemical purity could be ensured, it is probable that a crystal let down into a highly saturated solution of the same salt would not act as a nucleus to it. The solution would, according to this theory, adhere to it as a whole, and being saturated or supersaturated, would not dissolve it.

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* British Association, Norwich Meeting, Section B.

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† See Chemical News, vol. xviii., p. 2.

To test this opinion, Mr. Tomlinson prepared, with very great care, a solution of the magnesia sulphate (two parts by weight of salt to one of water), which was filtered while boiling into a chemically clean flask in which the solution was again boiled, and while steam was issuing from the neck, a short wide tube attached to a wire, filled with crystals of the salt, all made chemically clean, was suspended in the neck, which was plugged with cotton wool at the same time that the lamp was removed. The whole was left during about fifteen hours, when the tube with its crystals was gently lowered into the solution. There was no action of the crystals as nuclei, and they were left in the solution for 48 hours without any change taking place.

A similar solution was put into clean test-tubes plugged with cotton wool. The tubes were placed in sulphuric acid and covered with a receiver, from which the air was pumped out. In about twenty minutes a crystalline crust formed on the surface of the liquid which, during the shaking of the air pump, fell through the solution to the bottom, but it did not act as a nucleus. On removing the tubes and taking out the cotton wool the solutions immediately became solid from the entrance of some mote or dust floating in the air, which being chemically unclean acted as a nucleus.

The reading of Mr. Tomlinson's paper excited a lively discussion, in which the President (Dr. Frankland), Professor Williamson, Dr. Gladstone, Mr. Crookes, and others took part. They all wished for a definition of a dirty surface in contradistinction to a chemically clean one, Professor Williamson calling to mind the old adage as to dirt being merely "something in the wrong place." Mr. Tomlinson remarked in reply, that the various effects explained by his theory would hereafter be referred to a general law of adhesion; that there were a large number of facts at present much obscured by theory which admitted of easy explanation on this principle of chemical purity; that the investigation was a long one and was now in progress; but to give some idea of what may be understood by a chemically unclean surface and its mode of action, as compared with a chemically clean surface, dip a glass rod made chemically clean into soda-water; there will be no separation of the gas, because the solution will adhere to it as a whole; draw the glass rod through the hand slightly oiled or greasy, and then dip it into the soda water; it will be completely covered with gas, since there is an adhesion between a gaseous and an oily surface, while there is none between water and an oily surface. In like manner bodies that are exposed to the air contract an organic film from the condensation of the products of respiration and combustion, which film will adhere to the saline or gaseous particles of a solution, but not at all, or only imperfectly so, to the water of such solution. Hence there is a separation, and bodies are said to be active as nuclei when they have been exposed to the air, when in fact they have only become contaminated.

ON THE CHEMICAL COMPOSITION OF THE GREAT CANNON OF MUHAMMED II.,

RECENTLY PRESENTED BY THE SULTAN ABDUL AZIZ KHAN TO THE BRITISH GOVERNMENT.*

By F. A. ABEL, F.R.S.

This interesting example of heavy ordnance of early date, which has recently been added to the Museum of Artillery at Woolwich, is one of the large bombards which have, for about four centuries, occupied positions in the batteries on the Dardanelles. There appear, as recently as 1829, to have been upwards of sixty of these great cannon, but at the present time only eighteen are extant, several of which are of still larger calibre than the one now at Woolwich.

This one and other four of the bombards are referable to the period of Muhammed II., and an interesting account of the manufacture of these great pieces of ordnance, extracted from the MS. of a contemporary writer, is given by General J. H. Lefroy, R.A., F.R.S., in a paper on this gun and other great oriental cannon, recently read before the Royal Archæological Institute. These pieces of ordnance are specially interesting as constituting the only examples of guns which have continued to be applied to defensive purposes for four centuries. They are not mounted upon carriages, but rest upon oak-sleepers and are backed by strong walls, with the view of preventing their recoil when fired. Each gun can, therefore, only be brought to bear in one direction; nevertheless a remarkable illustration of their destructive powers, when applied even in modern engagements, was afforded upon the passage of the Dardanelles by Sir John Duckworth's squadron in 1807, when six vessels were struck by their means, a great number of men being killed and wounded.

The gun recently deposited at Woolwich bears the following inscriptions, which have been deciphered by Mr. Redhouse:—

1. Help, O God, the Sultan Muhammed Khan, son of Murad.
2. The work of Minver Ali in the month Rejeb.
3. In the date of the year Eight hundred and sixty-eight (A.D. 1464.)

An additional more modern inscription, near the vent, states that the weight of the shot is 240 okes (679 lbs.); powder due, 17½ okes (49½ lbs.); degrees, 3. Some spherical stone shot received with the gun weigh 670 lbs.

The gun consists of two parts, which are screwed together: each part weighs about 9 tons, the total weight of the piece being 18 tons 14 cwt. 3 qrs. Its external form is cylindrical, the muzzle being as large as the breech; each end of either separate part carries a projecting moulding which is divided by cross-bars into recesses. The object of these was not simply ornamental; the recesses obviously serve the purpose of the holes in a capstan-head, being required to give purchase to the levers employed in screwing the two parts together, and in moving the gun. Each piece has some simple moulding-ornamentation at the ends, and the external surfaces are sub-divided by rings or mouldings about 14 inches apart. The total length of the gun is 17 feet, the diameter of the powder-chamber is 10 inches, that of the bore is 25 inches. The two screws which join the pieces together, and are 23 inches in diameter, are skilfully cast.

Specimens of the alloy composing this interesting cannon were detached for analysis from the mouldings or projecting rims which exist at either end of each part of the cannon. The metal was found to be more or less thickly coated with suboxide of copper, which had here and there passed into carbonate. In some parts where porosity of the metal had been considerable, the oxidation had proceeded to depths ranging from 0·2 to 0·5 inch, and even upwards. The alloy was found to vary greatly in hardness, and most of the small specimens detached were porous, and differed from each other considerably in colour. Some presented the usual appearance of gun-metal of good quality (*e.g.* samples I. and IV.); in their immediate vicinity were found patches of white alloy (samples IA. and II.) rich in tin, such as are observed occasionally in bronze castings, in which the mixture of metals has been imperfect, or which have been allowed to cool very slowly; again, other portions (samples IIIA. and V.) more nearly resembled pure copper in colour and were comparatively very soft.

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* British Association, Norwich Meeting, Section B.

The proportions of copper and tin in the several specimens analysed are as follows:—

From the Moulding at Rear-end of the Breech-piece.

	I.	IA. (In close proximity to I.)
Copper	92·00	89·58
Tin .	7·95	10·15

From the Moulding at Front-end of the Breech-piece.

	II. Top of moulding.	III. Side of moulding.	IIIA.
Copper .	90·57	93·70	94·22
Tin . .	9·75	6·23	5·60

From the Moulding at Rear-end of the Chase.

	IV.
Copper . . .	91·22
Tin	8·49

From the Moulding at the Muzzle.

	V.
Copper . . .	95·20
Tin	4·71

Samples I. and IV. approach closely in composition to the best description of gun-metal of recent manufacture; Nos. IA. and II., which are comparatively rich in tin, exhibited specks of white alloy interspersed through the masses. Nos. III., IIIA., and V. contain higher proportions of copper than have been found in any other specimens of ancient gun-metal, the results of which have been published. Thus, the large Bhurtpore gun at Woolwich, which was cast in 1677, contains from 60·5 to 86 per cent. of copper in different parts of the gun[*]; a large bronze gun, also at Woolwich, one of four which were cast at Florence in 1750, contains 89 per cent of copper and about 10 per cent of tin.[†] The Malik i Mydax, or great gun of Bujapore, which was cast in 1548, is stated to contain only 80·42 per cent of copper and 19·57 per cent of tin; and the Dhool Dhanae, or great gun of Agra, which was cast in 1628, contains, according to the analyses made by the Assay Master in Calcutta in 1832, 92·7 per cent of copper and 7·3 per cent of tin near the muzzle, and 88·3 per cent of copper to 11·7 per cent of tin near the breech.

The great guns of the Dardanelles appear to have been produced from the metal of small cannon, and there is little doubt that no approach to an uniformity of mixture of the alloys composing those cannon could be attained with the crude means at command for melting the metal. It is, however, interesting to note that, in the seven specimens taken from the great gun now at Woolwich, which have been analysed, only traces of other metals than copper and tin have been discovered. Lead and iron were detected in minute quantities, and traces of antimony and arsenic were also discovered; but a careful examination of the specimens for gold, silver, and zinc failed to furnish any indication of the presence of these metals.

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[*] Abel on the composition of some interesting cannon. *Philosophical Magazine*, vol. 23, p. 181.

[†] Ibid, page 184.

ANALYSIS OF THE ANCIENT ROMAN MORTAR OF THE CASTRUM OF BURGH, SUFFOLK.[*]

By JOHN SPILLER, F.C.S.

A more than antiquarian interest attaches to the remains of Roman constructive work in this country, from the circumstance that they appear to have withstood the ravages of time much more successfully than most of the Norman and mediæval architectural monuments reared in much later periods. This superiority has been generally attributed to great simplicity in points of construction together with the use of imperishable materials, such as flints and rubble, and to a skilful preparation of the mortar employed to bind the stones together.[†] I was so much struck with the hard and enduring character of the Roman mortar used in the construction of Burgh, that I was induced to bring away with me a few samples for analysis on the occasion of my visiting the castrum in the years 1863 and 1866. The results of the chemical examination of these specimens are appended, but before proceeding to discuss the question of composition it would seem desirable to indicate briefly the circumstances of their occurrence.

Burgh Castle, Suffolk, the *Garianonum* of the Romans, is situate on an eminence near the junction of the rivers Yare and Waveney, and about five miles from Yarmouth. It is a mural erection in the form of an immense parallelogram, of which one side is wanting, being left unprotected on the river front. The massive walls are strengthened at the angles and at certain intermediate positions by towers or solid cylinders of masonry which are uniform in height with the rest of the work (*i.e.* about 15 feet), and measure from 40 to 50 feet in circumference, being larger at the top, and only in the case of the two corner towers being truly circular in form. The length of the wall on the eastern side, which is perfect throughout, with gate in the centre, I found to be 650 feet; whilst the north and south walls have fallen away in places, but their length may be roughly stated at 350 feet. The appearance of the whole is grand and highly picturesque; the walls, which are of rubble masonry and about 6 feet in thickness, are faced with flints and layers of red tiles set at intervals with great regularity, and the contrast of colour is heightened by parts of the work being overgrown with moss and ivy. The flints are arranged in tiers of four and occasionally five courses, and the red tiles invariably occur in triple layers with seams of mortar between; this order of construction is repeated some five or six times from base to rampart, with a cap of flints at the top, and the round towers or abutments present the same construction as the rest of the work. The walls vary in thickness, being, as already stated, generally about six feet, and are constructed internally of compact rubble, the stones being large and the mortar presenting throughout the reddish colour,—due to admixture of pounded brick,—which is considered to be characteristic of a Roman origin. The red tiles are of very fine texture, well burnt, and compact, for none of them appear to have been disintegrated by frost; their dimensions are tolerably uniform only as regards thickness, from 1¼ to 1½ inch, and they extend to various distances within the face of the wall, in some places 12 inches only and at others nearly twice that depth.

With respect to the probable antiquity of the structure I have been favoured with an opinion from Mr. C. Roach Smith to the following effect:—"These fortresses (Richborough, Lymne, Pevensey, and Burgh) instead of having been built at the early date popularly assigned to them were erected at a comparatively late period in the Romano-British epoch, to defend the coast against the incursions of the Saxons." It would appear, then, that at least fifteen centuries have elapsed since the foundations of these castra were laid.* and with the well authenticated knowledge that the Romans were conversant with the properties of burnt and slaked lime, and employed the latter in making their mortar, we have obviously the means of testing the action of time and atmospheric influences upon this hydrate placed in contact with sand and other silicious substances for lengthened periods. It becomes, then, important to ascertain the following chemical points in reference to the hardening of mortars:—

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[*] British Association, Norwich Meeting, Section B.

[†] *Vide* C. Roach Smith's Report on "Excavations at Pevensey," 1858, pp. 12, 14.

1st. To what extent the hydrate of lime becomes recarbonated by exposure to air?

2nd. What is the physical condition of the carbonate so produced? and

3rd. Whether in this long interval the silica and lime can directly unite with each other?

Different views on this subject have been advanced, the prevailing opinion undoubtedly being that the lime never becomes thoroughly recarbonated, but stops short at a point when a definite combination of hydrate and carbonate of lime is formed; and, secondly, that lime is endowed with the power of attacking sand and other forms of insoluble silica by long contact at the common temperature.†

The conclusions to which I have been led by the chemical examination of the ancient mortars from Burgh, Pevensey, and other Roman castra, is that the lime and carbonic acid are invariably united in monatomic proportions, as in the original limestone rock; and that there is no evidence of the hydrate of lime having at any time exerted a power of corroding the surfaces of sand, flint, pebbles, or even of burned clay, with which it must have been for lengthened periods in contact. Further that the water originally combined with the lime has been entirely eliminated during this process of recarbonation; and, this stage passed, the amorphous carbonate of lime seems to have become gradually transformed by the joint agency of water and carbonic acid into more or less perfectly crystallised deposits or concretions, by virtue of which its binding properties must have been very considerably augmented. It is proper to state that Messrs. Abel and Bloxam ‡ assign as one of the causes of the hardening of mortars, the formation and subsequent crystallisation of the carbonate of lime.

Reserving for the present the details of analysis of other Roman mortars, which in the main corroborate the results obtained in the examination of the specimens from Burgh, I have only to mention, as regards the process, that hydrochloric acid diluted with ten times its bulk of cold water was used for dissolving out the calcareous ingredients and leaving intact the sand and brick particles. Much of the latter was then separated by hand-sorting, and the weight of the remainder was deduced from the observed amounts of alumina and peroxide of iron obtained by fusion of the residue, after a special analysis had demonstrated the relation of these mixed oxides to the silica in the red brick. All pebbles weighing ten grains and upwards were excluded from the sample, these being deemed constituents of *concrete* rather than of builder's *mortar*. The grains of sand were sharp and angular, and the mode of searching for soluble silica was briefly as follows:—A large quantity of the Roman mortar was placed in contact with the diluted hydrochloric acid until all the lime was taken into solution as chloride of calcium. The physical character of this salt not permitting of the detection of soluble silica by direct evaporation of the liquid, I had recourse to the following expedient for concentrating any soluble silica which might be present in solution:—Ammonia was added until the reaction to test-papers became faintly alkaline, the result was the precipitation of mixed alumina, peroxide of iron, and a small quantity of carbonate of lime. This flocculent precipitate being filtered off retained all the soluble silica in combination, and being again dissolved in hydrochloric acid and evaporated to dryness with a small addition of pure chloride of sodium, left the whole of the contained silica insoluble upon digesting with acid. The accuracy of this method of proceeding was tested by preliminary trials with samples of Portland cement, both in the freshly burnt condition and after setting under water. The amount of soluble silica in the Burgh specimens was exceedingly small (0·4 per cent), proving that a "fat" lime was originally employed by the Romans, and that the lapse of centuries has failed to induce any kind of action from which the silication of the mass may be inferred.

To support my assertion that the lime has simply become converted into carbonate, I may mention that a special search for caustic lime by the nitrate of silver test failed to indicate its presence, whilst all recent mortars show an abundant precipitate of the brownish-grey oxide of silver; that the Roman mortar triturated with pure water gives no alkaline reaction with turmeric paper; and further, that the proportion of carbonic acid found in the Burgh samples is, within the limits of experimental error, exactly the amount which is required to combine with the lime in order to form the neutral carbonate. I would remind those who are inclined to place reliance on the statements regarding the silication of old mortars, that the proof is often wanting that the lime was itself free from soluble silica at the time of employment. Inferences can only be safely deduced from cases where there is clear evidence of a "fat" lime having been actually employed in the fabrication of the mortar, for so many varieties of lime, having modified hydraulic properties and gelatinising with acids, are known to result from the simple burning of blue lias and other argillaceous limestone rocks, that the absence of soluble silica at the first moment of preparation should not be always assumed.

Analysis of the Roman mortar and of the red bricks, or tiles, gave me the following results:—

Roman Mortar from S.E. Tower, Burgh.

	I.
Sand	54·50
Soluble silica	0·40
Red brick with some unburnt clay }	18·00
Carbonate of lime	25·75*
Sulphate of lime..	0·15
Carbonate of magnesia ..	0·08
Chloride of sodium	0·05
Magnetic oxide of iron ..	traces
Wood charcoal	traces
Water, chiefly hygroscopic	0·92
	99·85

Other Samples of Burgh Mortar.

	II.	III.	IV.
Sand and brick with a little unburnt clay }	72·3	71·4	67·0
Carbonate of lime, &c. (by difference) }	27·7	28·6	33·0

Samples II. and III. taken from the south wall. Specimen IV. from the north wall.

Red Brick or Tile from S.E. Tower, Burgh.

Silica	72·7
Alumina	14·0
Peroxide of iron	10·0
Lime..	2·1
Magnesia..	traces
Oxide of manganese ..	traces
Alkalies and loss	1·2
	100·0

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* *Vide* "The Antiquities of Richborough, Reculver, and Lymne," by C. Roach Smith, pp. 153, 179.

† *Vide* Knapp's "Technology," edited by E. Ronalds and T. Richardson, vol. ii., p. 396 and seq. General Gillmore's "Practical Treatise on Limes, Cements, and Mortars," New York, 1863, pp. 174, 186. Mr. G. R. Burnell's "Rudimentary Treatise on Limes, Cements, Mortars, &c.," p. 49.

‡ "Handbook of Chemistry," p. 296.

* Found, lime 14·5, carbonic acid 11·25 per cent.

In conclusion I would remark that the microscope very clearly demonstrates the mamellated crystalline character of the linings of cavities and other calcareous parts of the Burgh mortar; and further that my results are in general comformity with the analyses of ancient Roman, Greek, and Phœnician mortars published three years ago by Dr. W. Wallace in the Chemical News (Vol. xi., p. 185).

REPORT ON THE CHEMICAL NATURE OF CAST IRON.[*]

PART I.—ACCOUNT OF SOME EXPERIMENTS MADE TO OBTAIN IRON FREE FROM SULPHUR.

By A. MATTHIESSEN, F.R.S.,
and
S. P. SZCZEPANOWSKI.

Following out the plan indicated in the preliminary report presented to the Association in the year 1866, we have been endeavouring to prepare pure iron, but have encountered greater difficulties than we expected, owing to the great affinity which iron has for sulphur. Although we have not been able as yet to prepare iron absolutely free from sulphur, yet the results, as far as they have been obtained, may be of interest to the section, and a brief account of them is given in the following pages.

In the endeavour to prepare pure iron, we always found sulphuretted hydrogen on dissolving the metal in dilute hydrochloric acid. This small quantity of sulphur contained in the iron did not proceed from the hydrogen, or from the platinum tube in which the oxide was reduced. The manner of preparing the pure hydrogen, and the precautions taken with the platinum tube, will be described hereafter.

The first series of experiments were made by precipitating the hot, concentrated, clear solution of protosulphate of iron by oxalate of ammonium, washing the precipitate till the wash-waters no longer indicated sulphuric acid with chloride of barium, heating the dried oxalate of iron to redness in a platinum dish, and reducing the oxide thus obtained in a platinum tube. The reduced iron contained sulphur. In all the experiments we describe, sulphur was tested in the following manner:—The iron was placed in a test-tube with some dilute pure hydrochloric acid, and the gases were allowed to pass through a small tube fitted into a cork in the test tube, and to impinge on a paper moistened with acetate of lead. The evolution of sulphuretted hydrogen, after a very little experience, moreover, is just as easily detected by the smell.

Experiments were also made with the oxalate of iron by re-dissolving it in hydrochloric acid and re-precipitating with ammonia, or by dissolving the oxide obtained by heating the oxalate of iron in hydrochloric acid, and re-precipitating again by oxalate of ammonium. In all these cases the reduced iron contained sulphur.

The second series of experiments were made with the iron obtained from the crystalline oxide of iron.—It is well known that when protosulphate of iron is fused with chloride of sodium a crystalline oxide is obtained. For our experiments it was of course necessary to perform this operation in a platinum crucible, but it was found that the iron thus obtained contained a small quantity of platinum. We therefore employed, instead of chloride of sodium, the sulphate of sodium, and obtained an oxide which, after having been thoroughly washed and reduced, gave an iron containing sulphur. Experiments were then made by dissolving the crystalline oxide in pure hydrochloric acid and precipitating the solution by ammonia, washing the oxide, and reducing it. The iron thus prepared contained sulphur. The next experiments were made by dissolving the crystalline oxide in hydrochloric acid, digesting with chloride of barium for several days, decanting and filtering through paper (previously digested with dilute nitric acid), precipitating by ammonia (distilled from ammonia to which chloride of barium had been added), washing, and reducing the oxide. The iron thus prepared still contained sulphur.

The third series of experiments were made with sublimed proto- or sesqui-chloride of iron, by dissolving it in water, precipitating with pure ammonia, washing, and reducing in hydrogen. All the specimens thus prepared contained sulphur. The sublimed chloride was obtained sometimes from the red oxide, prepared by heating the oxalate of iron obtained as above described, or from the crystalline oxide by dissolving it in hydrochloric acid, digesting with chloride of barium, evaporating to dryness, and subliming either in platinum vessels or in porcelain tubes, or in clay retorts, either alone or in a current of chlorine or of hydrochloric acid.

In the fourth series of experiments, the metal produced by either of the above methods was submitted in the platinum tube, whilst red hot, alternatively to the influence of hydrogen and oxygen or hydrogen and steam, or of vapours of nitric acid and hydrogen, or of ammonia vapours, oxygen, and hydrogen. In all the cases the operation was repeated several times, and although sulphuretted hydrogen was given off during these operations, yet the iron always contained sulphur.

Further experiments were made by dissolving the purest iron in dilute acetic acid, and evaporating to dryness, and heating. The metal obtained still contained sulphur.

Also the iron obtained from ferrocyanide of potassium[*] was found to contain sulphur.

In fact we have never made or found a specimen of iron which did not contain sulphur. Even electrotype iron, said to be prepared from chloride of iron, evolved, by dissolving in dilute hydrochloric acid, a very appreciable quantity of sulphuretted hydrogen.

On the whole, we have made upwards of seventy series of experiments.

From the above it will be seen that we have not yet obtained a method of preparing iron free from sulphur. In fact, one great difficulty is to obtain vessels which will not give up sulphur to the iron in some form or another; for instance, the platinum tube had to be polished and boiled out with acid every time before use. It may be mentioned that the hydrogen employed was led through the platinum tube before reducing the oxide of iron for a quarter of an hour or more, and yielded no sulphuretted hydrogen.

Although no positive results have been obtained, we have in no ways lost hope of preparing iron free from sulphur. No doubt on a very small scale this might be done without much trouble; but we must bear in mind that our method must be such a one as to allow the reduction of pure iron on the ounce scale.

A GENERAL OUTLINE OF

A NEW SYSTEM OF CHEMICAL PHILOSOPHY.[†]

By Dr. OTTO RICHTER.

(Abstract by the Author.)

To this paper the author proceeds upon the hypothesis that the chemical elements consist not of individual atoms, but of entire groups of such atoms or molecules. The various kinds of molecules agree in being each or all built up of precisely the same number of atoms, which are symmetrically disposed with reference to the three axes of space according to the same fundamental plan of arrangement. The constituent atoms of these molecules are each or all endowed with the same three fundamental properties of gravity, original elasticity, and electrical energy, and these properties vary in range and intensity with each species. In harmony with the common practice, the chemical elements are divided into the two principal classes of the metals and the non-metals, represented respectively by the general formula M_2 and N_2. The constituent atoms are further supposed to be in a perpetual state of vibration, in which they perform a series of periodical contractions and expansions, and thus in their final effect establish between contiguous molecules and permanent tendency to repulsion, the result of which is the formation of a certain space round the centre of each molecule, which constitutes its specific volume, and is always directly proportional to the number of atoms set in motion. The volume-equivalents represent the maximum specific volumes which the elementary molecules are capable of realising; and the peculiar force, under the influence of which the vibratory movements of the atoms may *ad libitum* be arrested or restored, is called the paralytic force. The order in which this force performs its operations materially depends upon the particular portions which the various constituents occupy in the system relatively to each other. This law of Rankurder is indicated in the table of chemical equivalents in so far as any chemical element which there stands to the left or to the right of any other is supposed to occupy, in a certain sense, a similar position in comparison with any others with which it happens to be associated as a constituent member of the same type. The science of chemistry is divided into the two parts—Pondo-chemistry and Impondo-chemistry. The former treats exclusively of the molecular arrangement of the constituents; the latter exclusively of their specific volumes. Pondo-chemistry is divided into the two principal sections of meta-chemistry, which is subject to the dominions of the principles of polarity, and includes eleven distinct types; and of para-chemistry, which is subject to the dominion of the principle of parality, and includes three types or forms of molecular grouping. After giving a general description of these various types, the author discusses the law of volume-harmony, according to which the specific volumes of constituent members of a given volume-harmonious molecule are always reducible to some simple ratio contained in the volume-harmonious scale—$1 : m \times 1$; $1 : m \times 2$; $2 : m \times 3$; $3 : m \times 4$; $4 : m \times 5$; $5 : m \times 6$; $6 : m \times 7$—where m represents some integral number. The volume-harmonious molecules are divided into two classes. The first class comprises all those compounds where the water of crystallisation is excluded; in the second class all those compounds where the water of crystallisation is present. As regards the the latter class, it is a characteristic peculiarity that in the process of reduction the saline molecule, with every fresh addition of one molecule of water of crystallisation, experiences a loss in volume amounting always to a constant quantity. This quantity remains unaltered so long as this loss in volume is caused by the successive paralysation of its envelope molecules; but when this process of reduction extends to the molecules of the nucleus, the constant quantity in some cases continues the same, but in general it merges into another constant quantity. As regards further details we must refer the reader to the original, which is now in the course of being published.

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[*] British Association, Norwich Meeting, Section B.

[*] Crystallised out of a solution containing chloride of barium.

[†] British Association, Norwich Meeting, Section B.

Dr. Odling's Manual of Chemistry.—In the autumn will be published, in octavo, "A Manual of Chemistry, Descriptive and Theoretical." Part II. By William Odling, M.B., F.R.S., Fellow of the Royal College of Physicians, and Lecturer on Chemistry at St. Bartholomew's Hospital. The second part, now announced, will include an account of carbon, with its methylic, formic, and cyanic compounds; also of silicon, boron, and the monad, dyad, and triad metals, with their principal salts.

ON SOLID AND LIQUID FATS.

By HORACE DOBELL, M.D., &c.,

Senior Physician to the Royal Hospital for Diseases of the Chest, &c.

The hypothesis which I published in the *British Medical Journal* for January, 1866, involving the suggestion that an important distinction is to be drawn between the physiological properties of solid and liquid fats, as constituents of the animal body, and as ingredients of food and medicine, has called forth many criticisms, and I have been frequently challenged to produce more detailed grounds for my opinions.

I should have published the desired details but for the deficiency of some important links in the evidence, which I have been among the first to admit and very anxious to supply. It must be observed, however, that I have never myself claimed for my views on this subject a higher rank than that of hypothesis, and I refrain from doing so until the missing links necessary to a complete theory shall have been supplied.

My object in now bringing the subject before the readers of the Chemical News is to ask for assistance in certain chemical investigations necessary to the settlement of some of the questions at issue.

So far as I am able to learn, after a very careful investigation, there is a singular absence of precise knowledge as to the relative properties of solid and liquid fats, except in regard to their saponification, and, at the same time, a remarkable want of appreciation of the probable importance of the subject; the result of which is a corresponding disinclination on the part of scientific chemists and physiologists to enter upon the necessary experiments.

A good chemist, with the command of a laboratory, and an acquaintance with the manipulation of fats, is essential to the enquiry; and I have not, up to the present time, succeeded in finding such a person with time at his disposal willing to engage in the necessary experiments, while my own professional occupations preclude me from entering upon them without such assistance. I hope that this paper may discover some one, qualified and willing either to join with me or to prosecute the experiments single handed. In either case, I shall be happy to give him all the assistance in my power.

The most usual objections to my views, as to the importance of distinguishing between solid and liquid fats, with which I have met among medical men have been based upon the similarity in the chemical formulæ for stearin, margarin, palmitin, and olein. Such objections will of course have little weight with those acquainted with isomerism; on the contrary, it appears to me that the peculiar isomeric modifications of which stearin and palmitin are susceptible, as shown by Duffy, pointedly distinguish them from olein, which, so far as at present known, has not this susceptibility, a distinction which is supported by the different behaviour of oleic acid towards chlorine and bromine, from that of stearic or margaric acids (Lefort), and by the different action of bile upon stearic acid and upon oleic acid (Marcet).

But I think we ought to be prepared to learn that solid and liquid fats differ in some important physiological properties, by the first general fact concerning the constitution of all natural fats—viz., that they are mixtures in varying proportions of at least four different bodies, of which the melting points so widely differ—stearin melting at 144° F., palmitin at 114·8° F., margarin (probably a compound of stearin and palmitin) at 116° F., while olein remains fluid at 32° F.

That the different degrees of solidity of fats depend upon the proportions in which the solid ingredients are mixed with olein, that olein has a peculiar power of dissolving the solid ingredients, and that the melting point of the mixture is thereby reduced, appear to me to be facts pointing in the same direction as the foregoing, especially when we remember that the affinity of oleic acid for oxygen is much greater than that of the other fatty acids.

The fatty bodies obtained from warm-blooded animals are generally solid at ordinary temperatures, whilst those from fish and from cold-blooded animals are liquid. And when we consider the high melting points of the solid fats as compared with the temperature of the body in warm-blooded animals, it is evident that the fat in them would be solid at the temperature of their blood, but for the mixture of olein, by which the melting point is reduced. Therefore the solidity or fluidity of the fat in living animals is determined by the proportion of olein, which is able to be mixed with the stearin, palmitin, and margarin in each individual; and we are forced to conclude, either that it is of no importance whether the fats of the body during life are in a solid or liquid state, or that it is important in what proportion the olein, stearin, &c., shall be combined.

It has been already proved, by experiments on the fattening of cattle, that the solidity or fluidity of the fat in the body varies with the food—that cattle fattened upon linseed cake, for example, accumulate, in their adipose tissue, an oily material of unusual fluidity (Draper), and that the consistence of butter is dependent upon the kind of food given to the animals from which it is produced (Fownes).

The fat in animals is particularly liable to accumulate immediately beneath the cutis, in the omentum, and around the kidneys; and the fat found in the latter situation, where it is subject to a more uniformly elevated temperature than in the integument, is well known to be of a more suety character—that is to say, it contains a smaller proportion of olein, and has a higher melting point. These familiar facts point again to some importance in the animal economy, attaching to the melting point of the fat and the consequent degree of fluidity in which it should exist during life.

With regard to the fat of the integument—the principal deposit of adipose tissue in the body—it appears to me self-evident that the fluidity of this fat must vary with the temperature of the atmosphere in which the animal is placed; to what extent this is the case, is, in my opinion, a most important subject for enquiry, and although the experiments to determine the question are yet deficient, I hope soon to be able to supply them.

In conclusion, what I now suggest as a general proposition, is this:—That, in all probability, the stability of the fats of the animal body in resisting too rapid oxidation is dependent upon the degree of solidity which they possess at the temperature of the living animal at any given time; that alterations in external temperature may affect the solidity of the adipose tissue of the integument, and, consequently, its power of resisting oxidation; and that, therefore, in all probability, it is of great importance that the food of an animal shall contain a certain proportion of material capable of supplying the adipose tissue with *solid* fat.

The principal questions which I wish to submit to chemists, as requiring to be settled by their experiments, are the following:—

1. What is the relative facility for oxidation of the solid and liquid fats at similar and at different temperatures?
2. Is the facility for oxidation inversely as the melting points?
3. Is it the same for all fats at their melting points?
4. After the melting point of a fat has been attained, is the facility for oxidation affected by further increments of temperature?
5. Is there a temperature at which fats cease to be oxidisable, and if so, what relation does this bear to the melting point in each instance?

84, Harley Street,
Aug. 19, 1868.

ON THE SOURCE OF LIGHT IN LUMINOUS FLAMES.*

By Professor FRANKLAND, F.R.S.

The most prolific source of error amongst mankind is the unquestioning acceptation of authoritative opinion. However much we may pride ourselves upon the sifting of the explanations of things by our own enlightened judgments, it cannot be denied that the *ipse dixit* mode of settlement is still wonderfully frequent amongst us. Not only is this the case with the public in general, but even the cultivators of science are not entirely innocent of the same weakness.

The essential difference between a fact and a theory is not always appreciated with sufficient vividness. The statement that "sixteen parts by weight of oxygen unite with two parts of hydrogen to form water," is considered by many, for instance, as perfectly synonymous with the assertion that "one atom of oxygen unites with two atoms of hydrogen to form water."

The existence of an imponderable ethereal medium filling all space is often regarded as equally certain with the presence of a gaseous envelope surrounding our globe.

The atomic theory and the hypothesis of an ethereal medium are, at present, absolutely necessary, the one to the progress of chemistry, the other to the further development of physics; but neither this circumstance nor the splendid discoveries made by their aid can establish their truth. A mathematician starting from false data is sure to arrive at a false result; but it is far otherwise with theory, for false theories can, and constantly do, conduct to true facts. Thus Columbus's counterpoise theory of the earth led to the discovery of America, although that theory was nevertheless essentially false.

The most sober worker in science cannot progress without the assistance of theory to co-ordinate his facts, and to lead him on to further research. It is here that even a false theory is invaluable, and it is only when the theory continues to be held after it has become opposed to facts, that it exercises a prejudicial influence upon the progress of science. Then it hinders rather than expedites the advance of the experimenter, and ought to be at once abandoned.

In pursuing the investigation forming the subject of this discourse, the speaker had been compelled thus to abandon a theory of the source of light in luminous flames, which he, in common with others, had derived from Davy's classical researches on flame.

Our text-books answer the question, What is the source of light in a luminous gas or candle flame? in the most positive and unanimous manner.

Selecting from some of the most celebrated, the following quotations may be made:—

"All our artificial lights depend upon the ignition of solid matter, in the intense heat developed by the chemical changes attendant on combustion."—*W. A. Miller.*

"Whenever hydrocarbons are imperfectly burnt, there is a deposition of carbon, and this temporary deposition of carbon is an essential condition for the production of the white light required in an ordinary flame."—*Williamson.*

"The illuminating power of the gas flame is therefore due to these carbon particles, which are afterwards burned nearer the border of the flame."—*Balfour Stewart.*

"The brightness or illuminating power of flame depends not only on the degree of heat, but likewise on the presence or absence of solid particles which may act as radiant points. A flame containing no such particles emits but a feeble light, even if its temperature is the highest possible."—*Watts.*

The speaker then proceeded to investigate a number of different flames: he showed that there are many flames possessing a high degree of luminosity which cannot possibly contain solid particles. Thus the flame of metallic arsenic burning in oxygen emits a remarkably intense white light; and as metallic arsenic volatilises at 180° C., and its product of combustion, arsenious anhydride, at 218° C., whilst the temperature of incandescence in solids is at least 500° C., it is obviously impossible here to assume the presence of ignited solid particles in the flame. Again, if carbonic disulphide vapour be made to burn in oxygen, or oxygen in carbonic disulphide vapour an almost insupportably brilliant light is the result; now fuliginous matter is never present in any part of this flame, and the boiling point of sulphur (440° C.) is below the temperature of incandescence, so that the assumption of solid particles in the flame is here also inadmissible. If the last experiment be varied by the substitution of nitric oxide gas for oxygen, the result is still the same; and the dazzling light produced by the combustion of these compounds is also so rich in the more refrangible rays that it has been employed in taking instantaneous photographs, and for exhibiting the phenomena of fluorescence. Lastly, amongst the chemical reactions celebrated for the production of dazzling light, there are few which surpass the active combustion of phosphorus in oxygen. Now phosphoric anhydride, the product of this combustion, is volatile at a red heat,[*] and it is therefore manifestly impossible that this substance should exist in the solid form at the temperature of the phosphorus flame, which far transcends the melting point of platinum.

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* A Lecture delivered before the Royal Institution of Great Britain Friday, June 12, 1868.

For these reasons, and for others which the speaker had stated in a course of lectures on "Coal-Gas," delivered in March, 1867, and printed in the *Journal of Gas Lighting*, he considered that incandescent particles of carbon are not the source of light in gas and candle flames, but that the luminosity of these flames is due to radiations from dense but transparent hydrocarbon vapours. As a further generalisation from the above-mentioned experiments, he was led to the conclusion that dense gases and vapours become luminous at much lower temperatures than aëriform fluids of comparatively low specific gravity; and that this result is to a great extent, if not altogether, independent of the nature of the gas or vapour, inasmuch as he found that gases or low density, which are not luminous at a given temperature when burnt under common atmospheric pressure, become so when they are simultaneously compressed. Thus mixtures of hydrogen and carbonic oxide with oxygen emit but little light when they are burnt or exploded in free air, but exhibit intense luminosity when exploded in closed glass vessels, so as to prevent their expansion at the moment of combustion.

In a communication just made to the Royal Society the speaker had described the extension of these experiments to the combustion of jets of hydrogen and carbonic oxide in oxygen under a pressure gradually increasing to twenty atmospheres. These experiments, which were conducted in the laboratory of the Royal Institution, were made in a strong wrought-iron vessel furnished with a thick glass plate of sufficient size to permit of the optical examination of the flame. The appearance of a jet of hydrogen burning in oxygen under the ordinary atmospheric pressure was exhibited. On increasing the pressure to two atmospheres, the previously feeble luminosity was shown to be very markedly augmented, whilst at ten atmospheres' pressure, the light emitted by a jet about one inch long was amply sufficient to enable the observer to read a newspaper at a distance of two feet from the flame, and this without any reflecting surface behind the flame. Examined by the spectroscope, the spectrum of this flame is bright and perfectly continuous from red to violet.

With a higher initial luminosity, the flame of carbonic oxide in oxygen becomes much more luminous at a pressure of ten atmospheres than a flame of hydrogen of the same size and burning under the same pressure. The spectrum of carbonic oxide burning in oxygen under a pressure of fourteen atmospheres is very brilliant and perfectly continuous.

If it be true that dense gases emit more light than rare ones when ignited, the passage of the electric spark through different gases ought to produce an amount of light varying with the density of the gas; and the speaker showed that electric sparks passed as nearly as possible, under similar conditions, through hydrogen, oxygen, chlorine, and sulphurous anhydride, emit light, the intensity of which is very slight in the case of hydrogen, considerable in that of oxygen, and very great in the case of chlorine and sulphurous anhydride. On passing a stream of induction sparks through the gas standing over liquefied sulphurous anhydride in a strong tube at the ordinary temperature, when a pressure of about three atmospheres was exerted by the gas, a very brilliant light was obtained. A stream of induction sparks was passed through air confined in a glass tube connected with a condensing syringe, and the pressure of the air being then augmented to two or three atmospheres, a very marked increase in the luminosity of the sparks was observed, whilst on allowing the condensed air to escape, the same phenomena were observed in the reverse order.

Way's mercurial light was also exhibited as an instance of intense light produced by the ignition of the heavy vapour of mercury.

The gases and vapours just mentioned have the following relative densities—

Hydrogen	1
Air	14·5
Oxygen	16
Sulphurous anhydride	32
Chlorine	35·5
Mercury	100
Phosphoric anhydride	71 or 142

The feeble light emitted by phosphorus when burning in chlorine seems, at first sight, to be an exception to the law just indicated, for the density of the product of combustion (phosphorous trichloride) 68·7 would lead us to anticipate the evolution of considerable light. But it must be borne in mind that the luminosity of a flame depends also upon its temperature, and it can be shown that the temperature in this case is probably greatly inferior to that produced by the combustion of phosphorus in oxygen. We have not all the necessary data for calculating the temperature of these flames, but, according to Andrews, phosphorus burnt in oxygen gives 5,747 heat units, which, divided by the weight of the product from one grain of phosphorus, gives 2,500 units. When phosphorus burns in chlorine, it gives only, according to the same authority, 2,085 heat units, which, divided as before by the weight of the product, gives 470 units. It is therefore evident that the temperature in the latter case must be greatly below that produced in the former, unless the specific heat of phosphoric anhydride be enormously higher than that of phosphorous trichloride. The speaker had, in fact, found that if the temperature of the flame of phosphorus, burning in chlorine, be raised about 500° C. by previously heating both elements to that extent, the flame emitted a brilliant white light.

To return to ordinary luminous flames, the argument of the necessity of solid particles to explain their luminosity obviously falls to the ground; and a closer examination into the evidence of the existence of these particles reveals its extreme weakness. Soot from a gas flame is not elementary carbon, it always contains hydrogen. The perfect transparency of the luminous portion of flame also tends to negative the idea of the presence in it of solid particles. The continuous spectrum of gas and candle flames does not require, as is commonly supposed, the assumption of solid particles. The spectra of the flames of carbonic oxide in the air, of carbonic disulphide, arsenic, and phosphorus in oxygen, are continuous, and so, as we have seen, is that of hydrogen burning in oxygen under a pressure of ten atmospheres. It is to the behaviour of hydrocarbons under the influence of heat that we must look for the source of luminosity in a gas flame. These gradually lose hydrogen, whilst their carbon atoms coalesce to form compounds of greater complexity, and consequently of greater vapour density. Thus marsh-gas (CH_4) becomes acetylene (C_2H_2), and the density increases from 8 to 13. Again, olefiant gas (C_2H_4) forms naphthaline ($C_{10}H_8$), when the vapour density augments from 14 to 64. These are some of the dense hydrocarbons which are known to exist in a gas flame, but there are doubtless others still more dense; pitch, for instance, must consist of the condensed vapours of such heavy hydrocarbons, for it distils over from the retorts in the process of gas-making. Candle flames are similarly constituted. The direct dependence of the luminosity of gas and candle flames upon atmospheric pressure, also strongly confirms the view that the light of these flames is due to incandescent dense vapours.

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[*] Davy mentions this fact in connection with his view of the source of luminosity in flames, and endeavours to explain the, to him, anomalous phenomenon. He says:—"Since this paper has been written, I have found that phosphoric acid volatilises slowly at a strong red heat, but under moderate pressure it bears a white heat; and in a flame so intense as that of phosphorus, the elastic force must produce the effect of compression."—*Davy's Works*, vol. vi., p. 48.

This inquiry cannot be confirmed to terrestrial objects. Science seeks alike for law in the meanest and grandest objects of creation. From questioning a candle she addresses herself to suns, stars, nebulæ, and comets; the same considerations which have just heen applied to gas and candle flames are equally pertinent to these great cosmical sources of light.

NOTICES OF BOOKS.

Scientific Blue Books, No. 2. The Ninth Report of the Medical Officer of the Privy Council, with Appendix. London.

The work under notice deserves to meet with a very extensive sale, from the quantity of information from the pens of Messrs. Simon, Frankland, and Thudicum.

We wish in the first place to draw more particular attention to the work in spectroscopy done by the latter gentleman. The object of research was to discover if anything peculiar to cholera might be made physically evident; in fact, to detect the virus that the test-tube and microscope have hitherto failed to find.

Some rice-water evacuation from the colon, half an hour after its removal, evolved sufficient gas to lift off the heavy glass stopper of the bottle in which it was contained. As regards this gas, the evidence of incipient fermentation, the following percentages will give valuable information:—

	Nitrogen.	Carbonic Acid.
1st 24 hours' gas ..	99 per cent	1 per cent
2nd ,, ,, ..	52 ,,	48 ,,
3rd ,, ,, ..	37·5 ,,	62·5 ,,

During the first twenty-four hours 400 c.c. of rice-water evolved 75·25 c.c. of gas in a tube over mercury. A flocculent deposit in the discharge forms half of the bulk of the liquid, and consists of epithelium patches, scales, and vibriones; the filtrate could not be obtained quite clear from these bodies, and the deposit further materially interfered with the process of dialysis, decomposition continuing during both filtration and dialysis. The dialysate of the alkaline rice-water had an acid reaction, and gave a crystalline body resembling leucine, combining with nitric acid; an oily substance giving a pink reaction with nitric acid, soluble in water; butyric acid combined with the added barium, inorganic salts in considerable quantity; no urea could be discovered. The fermented clear liquid was then submitted to the spectroscope; this had not been dialysed, for none of the colouring matters pass through the dialyser. The ingredients of rice-water evacuation (described, by the way, as rice-water throughout the report) are—Vibriones, cells from the surface of the intestine, granular *débris* of cells, mucine, modified hemochrome, albumen, albuminous body giving rose-pink reaction, butyric acid, acetic acid, ammonia, leucine, inorganic salts. It is in an active state of decomposition and evolves gas, which at first is composed almost entirely of nitrogen; soon, however, carbonic acid prevails, and ultimately nothing but carbonic acid is evolved. At one period some hydrogen is developed.

The following is an account of the instruments and methods employed by Dr. Thudicum in the spectroscope examination of the colouring matters of cholera urine:—

For the observation of the ordinary non-magnified spectrum, Dr. Thudicum employed a number of spectroscopes of his own construction. These consisted each of a large sulphide of carbon prism. The prism was placed in a drum-shaped dark chamber, to which a tube with a fixed slit and condensing lens was adjusted at the proper angle. The spectrum was seen entire through an oblong opening in the side of the drum. The light was made to pass through the problematical solution; its rays were purified at the slit, made parallel at the lens, and broken prismatically in the sulphide of carbon wedge. The eye at the other side received the entire spectrum as modified by the interposed fluid, and was easily able to define the great features of these modifications by comparison with the normal spectrum when the interposed fluid was withdrawn.

The advantages of such a simple spectroscope were repeatedly illustrated in the course of these researches by the instantaneous observation of peculiarities, which could not so easily be seen in the magnifying spectroscope, and might have escaped observation by means of this latter instrument.

Dr. Thudicum also employed a spectroscope constructed upon the original plan of Bunsen. With this instrument a telescope magnifying about four times was employed. The slit of this instrument was movable, and a glass prism could be adjusted to it, so that the normal and altered spectrum could be made to appear simultaneously the one above the other.

But although valuable observations and general comparisons could be made by these instruments, and although their spectra were of great purity and precision, yet they admitted of no accurate measurements, and the changes of temperature unavoidable in a chemical laboratory, and very great in a frail wooden structure caused undesirable currents in the sulphide of carbon prisms.

By the side of these instruments a spectrometer by Mr. Ladd was employed, which was provided with two flint-glass prisms, and beside the slit-tube, with a telescope. While in Bunsen's original spectroscope the entire spectrum is brought into view by turning the prism, in this spectrometer the telescope is made to move upon an arm, which centres somewhere in the middle of the disc which carries the prisms.

This arrangement gave a very good spectrum. By means of the easy motion of the telescope the platinum wire on the diaphragm of the eye piece could be brought into close adjustment to the margin of any spectral lines or bands. The arm carrying the telescope could then be clamped, and the final adjustment be made by means of a fine-threaded screw. The position of the wire could then be learned by reading the position of the index on the divided quadrant of the disc. The only inconvenience attaching to this instrument was that the observer had to rise after every observation in order to read off the scale. This should be avoided in the construction of any similar apparatus, by engraving the scale on a broad ring, and making it readable through a short system of glasses, having its eye piece just underneath that of the telescope.

The spectrometer, with diffuse sunlight or the light of a lamp, burning gas, paraffin oil, or tallow, gives a good large spectrum. It was at first attempted to measure this spectrum by determining the D line by means of sodium, and then making this a zero point by measuring from it in two directions. But the description of the direction being found inconvenient, the principal Fraunhofer lines of this spectrum were determined by means of a heliostat. Every change produced in the spectrum by substances to be analysed could thus be referred to the only fixed points in the spectrum, the lines of Wollaston and Fraunhofer.

But in this process the following difficulty arises. The lines of the entire spectrum cannot be read with the same adjustment of the eye-piece. This difficulty arises with all magnifying spectroscopes, and spectrologists have adopted the device of avoiding it, by seeing their spectra with what is termed "medium clearness." A certain portion of the clearness of one part of the spectrum is sacrificed in order to be able to see with the same adjustment another part of the spectrum, which, if the first were viewed absolutely well defined, would not be defined at all. But with this medium clearness, which serves very well for the spectra of hot metallic gases and for ordinary observation of absorption phenomena, the eye cannot fix the solar lines of the entire spectrum so as to read them off repeatedly with the same accuracy. When proceeding from the red to the violet end of the solar spectrum we arrive at E and *b*, or the middle and end of green, at a region where it becomes necessary to shorten the focus by pushing in the eye-piece a little, in order to obtain a fair congruity of the eye-piece wire and the lines of the blue and violet part. This produces what may be called an *artificial or telescopic irrationality* of the spectrum, which destroys a little the accuracy of the relations of both its wings to each other in the metric conception. But if both wings are considered separately, all measurements lying between A and *b* on the one hand, and between *b* and the violet end on the other, are, with the best adjustment obtainable, accurate amongst themselves. For the rest, this source of relative error happily affects the principal points of the following observations very little, inasmuch as the phenomena to be discussed are mainly situated in the first or red end part of the spectrum.

We are thus enabled to attribute their actual and no exaggerated value to the following determinations:—

When the platinum wire of the eye-piece covered a line X, seen with the best adjustment obtainable for one-half of the spectrum, the point of the arrow on the indicator of nonius stood upon Y degrees Z minutes.

Single minutes could no longer be read. Two and three could be estimated. The constantly changing intensity of the brightest sun-light produced slight variation in the readings, so did the inaccuracies of the heliostat. But ultimately the following measurements were assumed as determined:—

Red end of spectrum	143°.	(Difficult and changeable).
A	142° 54′	
a	142° 42′	
B	142° 30′	
C	142° 18′	
D	141° 42′	
E	140° 48′	
b	140° 36′	Focus shortened; eye-piece pushed in.
F	140°	
G	138° 24′	
H	136° 54′	
H′	136° 48′	
Violet end	136° 18′	(Most difficult to determine).

By repeated observation it was found that the ends of the spectrum could not be absolutely determined within a fluctuation of 0° 6′. But the error never had wider limits. The same was ascertained to be the chance of error in the reading of the terminals of feeble absorption bands. "My readings might differ by 0° 6′ from each other, or the readings of my assistants might differ from my own by 0° 6′, but rarely or never more. But when the bands were dark and well defined, such as blood bands, or the bands of concentrated hæmatine solution, any number of readings made successively by myself or my assistants would always give the same results."

(To be continued.)

CORRESPONDENCE.

GERHARDTISM.

To the Editor of the Chemical News.

Sir,—The depression of my spirits, consequent upon a compulsory return to the laboratory from a more highly ozonised region, has been greatly relieved by the perusal of your excellent journal of the 24th of July, from which I learn, with unspeakable pleasure, that one of our most distinguished chemists is exhibiting decided indications of recovery from Gerhardtism, from which he was one of the first to suffer on the outbreak of the disease in this country.

The distressing character of the attack may be inferred from the following extracts from that magnificent fragment, his "Manual of Chemistry" (Longmans, 1861).

At page 10, we find that "the essential character of an acid is its capability of exchanging hydrogen for a metal;" and again at page 11, that "an acid is a *hydrogenised* body, which, when treated with hydrate of potassium, can exchange hydrogen for potassium, with simultaneous formation of water."

Now, Sir, you will, I think, agree with me that we must hail the following as an unmistakable symptom of approaching convalescence:—"Further, in considering the properties of disulphide of carbon, we shall find that it acts as an *anhydrous acid*, combining directly with bases to form definite salts, strictly comparable with the ordinary carbonates produced by the *direct combination of carbonic acid with bases*."—(Chemical News, July 24, p. 41.)

The statement that liquefied carbonic acid gas is heavier than water, a line or two earlier, shows that the mind has not yet entirely recovered its admirable powers.—I am, &c.,

A. N. Hydride.

SULPHOCYANIDE OF AMMONIUM.

To the Editor of the Chemical News.

Sir,—Being obliged to prefer an invigorating tour in Scotland to attendance at the Norwich Meeting of the British Association, I had not an opportunity of making remarks on a paper read before the Chemical Section by Dr. T. L. Phipson, F.C.S.

I am a good deal astonished at the fact stated by him of his having found some sulphate of ammonia of commerce to contain 75 per cent of sulphocyanide of ammonium. Some twenty years ago it was the custom to saturate the ammoniacal water of the gas manufacture with sulphuric acid, then to evaporate and crystallise. At that time the greater part of the sulphate of ammonia of commerce was contaminated with sulphocyanide; more recently, the almost invariable mode in use has been what is technically called blowing the sulphates—that is, blowing high pressure steam into the gas water, and conveying the vapours containing all the volatile compounds into sulphuric acid; sulphate of ammonia so produced contains no sulphocyanide, as that compound is not volatile. I am at this time operating upon a lot of 20 tons, from Glasgow, bought without any stipulation beyond its percentage of ammonia, and it does not contain the slightest trace of sulphocyanogen; I therefore conclude, that what Dr. Phipson found to contain 75 per cent of sulphocyanide must have been a very exceptional article.

The chief matters of scientific interest in Dr. Phipson's paper is the mode by which he separates the sulphocyanogen compound. It so happens that some three years ago I obtained provisional protection for a process for the manufacture of sulphocyanide of ammonium, of which Dr. Phipson's mode is in so far an exact reproduction, only he does not carry it out so as to complete it as a practical process.

I found the residual gas waters, after all the volatile compounds were blown off, to be rich in sulphocyanides; to this liquor, concentrated, I added a mixed solution of protosulphate of iron and sulphate of copper; I had then a beautiful greyish-white precipitate of cupreous sulphocyanide. To obtain pure sulphocyanide of ammonium, as to which Dr. Phipson's paper in the report now before me gives no directions, I took advantage of the strong affinity of copper for sulphur. Sulphide of ammonium, however, as generally sold, is a dear and not a very pure compound; a strong solution of sulphate or chloride of ammonium was mixed up with soda waste fresh from the vats. Steam being blown into the mixture, there distilled off a strong and pure solution of NH_4S; this being added to the washed precipitate of cupreous sulphocyanide, double decomposition took place, and I had pure sulphocyanide of ammonium in solution. Many hundredweights of this salt were made, and the process was perfect, but, unfortunately, the demand for the article was extremely limited, pounds of it only were wanted where tons had to be produced in order to make it a profitable manufacture, and I put the thing aside.

I can, however, corroborate Dr Phipson as to the beauty of the crystals—they are of pure and dazzling whiteness, and often radiate in lengths of 6 to 8 inches in the crystallising vessel.—I am, &c.,

Peter Spence.

Manchester,
Aug. 31, 1868.

MISCELLANEOUS.

Embalming.—A subject treated by the patented carbolic acid process of Professor Seely, 103 days previously, was recently examined at the Bellevue Hospital by a number of scientific gentlemen, and found in perfect preservation. There was no smell, and the face was startling in its naturalness. The Professor was himself astonished to find that the success of the process was so complete. Decomposition had been absolutely prevented. In this case a simple solution of the acid was applied externally, and injected into the natural openings of the cavities of the body. It is, however, proposed, when there are no objections to making incisions, to inject it also into the veins. It is believed that thus prepared, the bodies will last a hundred years.

British Association for the Advancement of Science (Norwich Meeting).—At the concluding meetings the following recommendations were adopted:—

"That the committee on luminous meteors and aërolites, consisting of Mr. Glaisher, Mr. R. P. Greg, Mr. E. W. Brayley, Mr. Alexander Herschel, and Mr. C. Brooke, be re-appointed; Mr. Herschel to be Secretary."

"That the committee consisting of Dr. Tyndall, Dr. Lyon Playfair, Dr. Odling, Rev. C. Pritchard, Professor Kelland, Professor W. A. Miller, and Professor Foster, be re-appointed for the purpose of enquiring into the present methods of teaching the elements of dynamics, experimental physics, and chemistry in schools of various classes, and of suggesting the best means of promoting this object in accordance with the recommendations of the report of the committee appointed by the Council; and that Professor Foster and Dr. Odling be the Secretaries."

"That Lieut.-Col. Strange, Professors Sir William Thompson, Tyndall, and Frankland, Dr. Stenhouse, Dr. Mann, Mr. Huggins, Mr. Glaisher, Professors Williamson, Stokes, Fleming Jenkin, Hirst, Huxley, and Dr. Balfour Stewart, be a committee for the purpose of inquiring into, and of reporting to the British Association, the opinion at which they may arrive concerning the following questions:—1. Does there exist in the United Kingdom of Great Britain and Ireland sufficient provision for the vigorous prosecution of physical research? 2. If not, what further provision is needed, and what measures should be taken to secure it? That Dr. Robert James Mann be the Secretary."

Mr. Griffiths made the following statement of the number of tickets which had been issued at the Norwich Meeting:—196 old life, 18 new life members, 226 old annual, 117 new annual, 720 associates; 682 ladies, and 45 foreign members and their ladies; total 2,004.

NOTES AND QUERIES.

Picrate of Quinine.—Can any of your correspondents inform me if the above has been experimented upon, and if it is of practical use?—Berne.

Embalming.—Your correspondent "A Physician" will find the different *embalming* processes described in Garmal's "*Histoire des Embaumements et des Preparations des Pieces d'Anatomic.*" 8vo. Paris, 1838.

Rusting of Iron.—I should be obliged if any of your numerous subscribers would, through the medium of your valuable "Notes and Queries," inform me of a preparation which will prevent wrought iron from rusting, and at the same time be proof against attack of boiling caustic soda.—Engineer.

[Iron is almost completely preserved from rusting in the presence of caustic alkali.—Ed. C. N.]

TO CORRESPONDENTS.

Communications have been received from Rev. B. W. Gibsone, M.A.; Nicholson, Maule, and Co.; Mottershead and Co.; P. Holland (with enclosure); J. Parnell; Capt. W. A. Ross, R.A. (with enclosure); W. Schofield; J. T. Hodges (with enclosure); P. Squire; Professor Heaton; Professor Bloxam; Dr. T. L. Phipson (with enclosure); Professor Wanklyn; W. H. Perkin, F.R.S.; E. Beanes (with enclosure); D. Kemp (Bombay); W. B. Davis (with enclosure); Townsend and Adams (with enclosures); W. Hunter (with enclosure); G. W. Keyworth; J. Levinstein (with enclosure); F. C. Calvert and Co.; P. Spence (with enclosure); Magnesium Metal Co.; Dr. Horace Dobell (with enclosure); C. Tomlinson, F.R.S.; P. Sankey; and Dr. Kellner.

Several letters, notices, and papers for publication, included in the above acknowledgements, are unavoidably postponed till next week.

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Appendix A containing additional information on Sulphur, Sulphuric Acid, Bisulphide of Carbon, Chloride of Sodium, Soda, Hydrochloric Acid, Potash, Soap, Glycerin, Aluminium and Sodium, Magnesium, Soluble Stannates, Arseniate of Soda, Silicates of Potash and Soda, Chlorate of Potash, Phosphorus, Lucifer Matches, Hyposulphite of Soda, Boracic Acid, Soluble Phosphates, Nitrate of Soda, Gunpowder, Gun-cotton, Nitroglycerine, and Prussiate of Potash.

Appendix B, containing Abstracts of Specifications of Patents relating to the materials and processes described in this and previous volumes.

Appendix C, Tables connected with these processes.

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THE CHEMICAL NEWS.

Vol. XVIII. No. 458.

ON

THE ABSORPTION OF GASES BY CHARCOAL.*

By Dr. R. ANGUS SMITH, F.R.S.

Dr. Angus Smith, without reading a paper, said that he had somewhat farther extended his inquiries into the laws of absorption of gases, as shown by charcoal. He had some years ago said that he believed the actions were on the border between chemistry and physics, or that physical phenomena were an extension of the chemical. Last year, in a short note, he said that the gases which he tried were absorbed in whole volumes, or volumes which were multiples of hydrogen. He had now tried other gases. with the following results:—Hydrogen, 1; oxygen, 7·99; carbonic oxide, 6·03; carbonic acid, 22·05; marsh gas, 10·01; nitrous oxide, 12·90; sulphurous acid, 36·95; common air, 40·063. Nitrogen was found to be 4·27; probably this is a little too low, as there is always some nitrogen left in the heated charcoal. These numbers are got by dividing the number of volumes absorbed by each gas by the volumes of hydrogen absorbed. They are an average of many. The numbers, in some cases, differ considerably; it is supposed that the reason lies in the constitution of the charcoal, but some of it may lie in the mode of working. It seemed to him important to bring under some form of order those long observed but irregular actions which seemed little capable of being shown to be guided by a law; what that law is he did not see fully, but there distinctly was order.

He considered that the ultimate particles of gas rested as strata or layers in the charcoal; the nearer particles were, therefore, less forcibly held than the more distant. They were also most difficult to remove. If this physical action had an analogy with chemical action, it would also partially throw light upon it, and it seemed to point to compounds containing parts held together more or less loosely than other parts. The gas and charcoal form such a compound already in a sense not purely chemical.

The numbers, however, require analysis and careful thought. Two of them seem very remarkable—namely, oxygen and carbonic acid, as the volumes are exactly those of the weights of oxygen in water and of an atom of carbonic acid. Eight volumes of oxygen are 128 times heavier than one volume of hydrogen; the gases, therefore, do not seem to be taken up according to their atomic weights. By attention to this, he hoped that some light would be thrown on the atomic physical constitution of bodies.

In a practical point of view, he hoped to gain by the enquiry some knowledge of the phenomena of spontaneous combustion to which several substances are subjected.

Experiments on the absorption of mixed gases had been made, but were left for description when the paper was written, and also those on the extrusion of the gas by another.

He had a very long time ago illustrated the oxidising power of porous substances in reports to the British Association, perhaps so long ago that some persons thought it needful to do it again. No one, however, had succeeded so thoroughly as Dr. Stenhouse in this department.

Experiments on salts were not sufficiently telling, and a better mode of making them required to be found; but it was clear to him that the charcoal took up most readily those oxides the metals of which were less inclined to oxidise. The combinations being weaker, the bases were removed from the acid, a struggle against chemical action existing. In other words, an action with little chemical character opposed itself to the purely chemical, and by aid of mass gained something, a phenomenon which is frequent whenever chemical action is weak, and one which interferes much with exactness in analysis.

RESEARCHES ON THE ETHERS.*

By J. ALFRED WANKLYN,

Professor of Chemistry in the London Institution.

Five cubic centimetres of good acetate of ethyl and 0·3 gramme of sodium were sealed up in a small glass tube, and then heated in the water-bath to 100° C. until all the sodium had disappeared. The tube was then opened under water, and the gas which escaped measured 25 c.c. at the ordinary temperature of the air. Corrected at 0° C. and 760 m.m. pressure (dry), the volume of the escaped gas is about 23 c.c. If the volume of hydrogen which is equivalent to 0·3 gramme of sodium be calculated, it will be found to be about 140 c.c.

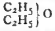
Therefore, this experiment establishes the fact that there is no evolution of hydrogen as a main product of the action of sodium on acetic ether. Moreover, the 23 c.c. of gas which escaped must be regarded as due to traces of alcohol in the acetic ether, and not as arising from minor secondary reactions on the acetic ether. About 2 per cent of alcohol present in the acetic ether (and such a quantity was very probably there) is sufficient to account for 23 c.c. of hydrogen.

Another sample of acetate of ethyl, which had been very carefully prepared, evolved no gas at all when acted on by potassium or sodium.

Acetate of Amyl and Sodium.—The acetate of amyl was very carefully deprived of all traces of amylic alcohol by being treated with glacial acetic acid and hydrochloric acid gas. After this treatment it gave correct numbers on titration. 0.6 gramme of sodium and 11 c.c. of acetate of amyl were sealed up in a small tube and heated to 100° C., until all the sodium had dissolved; the tube was then opened under water. Not a trace of gas was evolved. (Calculating the quantity of hydrogen equivalent to the 0·6 gramme of sodium it will be found to exceed 250 c.c.)

Butyrate of Ethyl and Sodium.—The ether boiled at 118·5° C., and was consequently the normal (not the iso) butyrate. On being titrated it gave very correct numbers.

Thirty-seven grammes of this butyric ether, 7·5 grammes of sodium, and 40 c.c. of dry common ether—



$$\left.\begin{matrix} C_2H_5 \\ C_2H_5 \end{matrix}\right\} O$$

were sealed up and heated very gently in the water-bath, and shaken up well during the progress of the reaction. The sodium dissolved without any evolution of gas. The experiment was repeated with the same result.

Valerianate of Ethyl and Sodium.—There is not the slightest evolution of gas when these materials act on one another.

Benzoate of Ethyl and Sodium.—Pure benzoic ether and sodium and common ether were sealed up and heated in the water-bath. There was action, but no evolution of gas.

From these experiments it is abundantly evident that free hydrogen forms no part of the product of the action of sodium on the ethers of the fatty and aromatic acids.

All the modes of explaining the action of sodium on acetic ether adopted by Geuther, Frankland, and Duppa during the last few years must therefore be abandoned. The well known, and in some respects admirable, memoirs of these chemists agree in representing the action of sodium as consisting in the evolution of an equivalent of hydrogen for every equivalent of sodium consumed.

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* British Association, Norwich Meeting, Section B.

* British Association, Norwich Meeting, Section B. Communicated by the Author.

Thus Geuther writes the following equation to express the action of sodium on acetic ether:—

Acetic Ether. Ethylate of Soda. New Body.

$$2C_4H_8O_2 + Na_2 = NaC_2H_5O + C_6H_9O_3Na + H_2.$$

Frankland and Duppa write:—

$$4C_4H_8O_2 + Na_2 = 2C_2H_6O + 2C_6H_9O_3Na + H_2.$$

Also:—

$$2C_4H_8O_2 + Na_2 = C_2H_6O + C_6H_8O_3Na_2 + H_2.$$

Also:—

$$2C_4H_8O_2 + Na_2 = 2C_4H_7NaO_2 + H_2.$$

Also:—

$$C_4H_8O_2 + Na_2 = C_4H_6Na_2O_2 + H_2.$$

All these equations affirm the evolution of as many equivalents of hydrogen as there are equivalents of sodium consumed. All of them are condemned.

In order to account for the strange error into which the eminent chemists just referred to have fallen, it will perhaps be enough to make the remark that they appear to have omitted to measure the equivalent of hydrogen which nevertheless figures in their equations.*

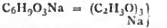
I have, on former occasions, represented the action of sodium on valerianic ether as consisting in the replacement of the acid-forming radical by sodium and the generation of free valeryl or sodium-valeryl, according to circumstances. A mode of representation of this kind will have to be adopted by chemists for the explanation of the reaction between sodium and acetic ether.

Geuther, Frankland, and Duppa agree (in this instance the agreement rests on an experimental basis) in representing a body having the formula $C_6H_9O_3Na$ as a product of the action of sodium on acetic ether. Geuther obtained and analysed it, and also the hydrogen, ethyl, and methyl derivatives of it. He also prepared some derivatives containing various heavy metals, and he investigated quantitatively a very interesting decomposition in which water plays a part, and in which acetone, alcohol, and carbonic acid are produced.

Frankland and Duppa have prepared the ethyl derivative. Altogether it is well made out that $C_6H_9O_3Na$ is produced, and that it is the main, if not the only, new compound *directly* resulting from the action of sodium on acetic ether.

Very complicated names have been given to it, viz., "Aethylen-di-methylencarbonsaure Natron," by Geuther, and "Ethylic-sodacetone-carbonate," by Frankland and Duppa.

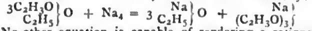
On making an inspection of the formula it will be seen that it is equal to three equivalents of acetyl and one of sodium:—



$$C_6H_9O_3Na = \left.\begin{matrix}(C_2H_3O)_3\\ Na\end{matrix}\right\}$$

and its production from acetic ether and sodium admits of the following formulation:—

Acetic Ether. Ethylate of Soda. Sodium-triacetyl.



$$3\left.\begin{matrix}C_2H_3O\\ C_2H_5\end{matrix}\right\}O + Na_4 = 3\left.\begin{matrix}Na\\ C_2H_5\end{matrix}\right\}O + \left.\begin{matrix}Na\\ (C_2H_3O)_3\end{matrix}\right\}$$

No other equation is capable of rendering a rational account of the production of $C_6H_9O_3Na$ from acetic ether and sodium without necessitating the assumption that there is evolution of hydrogen.

This equation affirms that 3 equivalents of ethylate of soda are complementary products to 1 molecule of the new compound: also that 4 equivalents of sodium are required to give 1 equivalent of sodium in the form of new salt.

The following experiments accord with these conditions: I took 2·4 gramme of sodium and dissolved it in excess of acetic ether in presence of dry common ether used as a diluent. When the reaction was over water was added, by which means, of course, ethylate of soda would be transformed into caustic soda and alcohol, more or less of the caustic alkali becoming acetate of soda by action on the excess of acetic ether. The difference between the total amount of sodium employed and the sum of the amounts of sodium found as caustic soda and as acetate of soda gives the quantity of soda forming the new compound. The following is a tabular statement:—

Grammes.
Sodium found caustic = 1·56
,, as acetate = 0·24
,, as new compound = 0·60

Sodium employed . . . . . . 2·40

Ratio of sodium employed to sodium as new compound—
2·40 : 0·60
or, 4 : 1

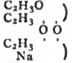
A similar experiment with potassium and without common ether as a diluent furnished an analogous result:

Grammes.
Potassium found caustic = 1·59
,, as acetate = 0·28
,, as new compound = 0·64

Potassium employed = 2·51

2·51 : 0·64 :: 3·92 : 1

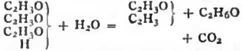
Sodium-tri-acetyl, $C_6H_9O_3Na$, admits of being regarded in different lights. For instance, it may be written thus: $(C_2H_3O)_3\,Na'''$, wherein the sodium is represented as being triatomic, or it may be written thus:—



$$\left.\begin{matrix}C_2H_3O\\ C_2H_3\end{matrix}\right)\ \dot{O}\ \dot{O}\ \left.\begin{matrix}C_2H_3\\ Na\end{matrix}\right)$$

wherein the three equivalents of acetyl are fused together to constitute a non-atomic tri-acetyl, $C_6H_9O_3$. Hydride of tri-acetyl, which is very well described by Geuther, is obtained by decomposing sodium tri-acetyl with glacial acetic acid, and is an oily liquid rather heavier than water; I have prepared some of it. The decomposition noticed by Geuther which it undergoes in contact with strong acids or alkalies, and in which the elements of water are taken up, is very interesting:—

Acetone. Alcohol.



$$\left.\begin{matrix}C_2H_3O\\ C_2H_3O\\ C_2H_3O\\ H\end{matrix}\right\} + H_2O = \begin{matrix}\left.\begin{matrix}C_2H_3O\\ C_2H_3\end{matrix}\right\} + C_2H_6O\\ + CO_2\end{matrix}$$

The formation of alcohol in this reaction is a virtual conversion of acetic acid into alcohol, inasmuch as the tri-acetyl came from acetic acid.

All the compounds mentioned in Frankland and Duppa's paper as derived directly from acetic ether and sodium admit of representation as sodium-triacetyl, and products derived from sodium-triacetyl, as I will explain on another occasion.

ON A PECULIAR ACTION OF LIGHT UPON THE SALTS OF SILVER.*

By Professor MORREN.

The molecular movements produced under the action of light present special interest, and in order to show my sympathy with this Association I present the results of some experiments, although they are at present not completed. The facts are these:—If in a tube of white glass from 14 to 15 inches long, and from 1 to 2 inches in diameter, you enclose moist chloride of silver freshly precipitated by means of a solution of chlorine in water, and expose it to the direct action of the solar rays, it will be observed that, while the chlorine solution is still yellow, the chloride of silver remains perfectly white; but afterwards, the chlorine solution becomes colourless and clear, and the chlorine decomposes the water under the action of light. As soon as the chloride of silver blackens at the surface it should be agitated from time to time, and left exposed for a few days to direct light until the whole becomes of a fine black colour.

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* More than twenty-four years ago Liwig and Weidmann investigated the action of potassium on acetic ether, and arrived at the result that ethylate of potash and a potash salt of a new organic acid, is the product, and that no gas is given off.—(*Ann. Ch. Pharm.*, xxxvi., 297). In 1864 (*Journal Chem. Soc.*, vol. ii., 371.), I called attention to these old researches, and confirmed the result in a general way. I showed that sodium and acetic ether might be heated in a bath, the temperature of which was 130° C., without any considerable evolution of gas of any kind. Geuther and Frankland and Duppa have contradicted a well established result without publishing any adequate experiment in opposition to it.

* British Association, Norwich Meeting, Section A.

Now take the tube into a dark place, and you will see the blackness disappear by degrees, chloride of silver becomes reformed, and the contents of the tube become perfectly white, although its structure is evidently different to what it was previous to its exposure to light. Then we may expose it afresh to the sun, and after it has again become black we can make it white again, and this experiment can be repeated indefinitely, and is an evidence that in those successive reactions the chlorine, oxygen, hydrogen, &c., preserve their properties of combination and recombination. These gases manifest the properties which we, in France, call the nascent condition—properties certainly electric, and which only in certain circumstances become evident, but which, without doubt, exist in all bodies when the circumstances are favourable. We have plenty of examples in connection with oxygen, hydrogen, and similar bodies. There is one special and striking example in the experiment which ought to be mentioned. If we place chloride of silver in a thin and fine tube, one millimetre internal diameter, and close it at one end, this little tube being placed in the larger one, its chloride becomes dark under the action of light, but once dark it remains always black, whilst its neighbour, under the alternate action of light and darkness, blackens and bleaches, a manifest evidence of the molecular movements induced by the light upon the chloride of silver when surrounded by a suitable liquid.

It is easy to comprehend the value of the knowledge of this property in photography. We see with what care we ought to get rid of our enemy, hydrochloric acid, from our sensitive papers; to dry them perfectly, and to deprive them of all hygrometric salts, for without doubt the image, especially the darker portions, will be liable to the decomposition and recomposition above described.

Bromide of silver presents the same properties and the same effects; but it is necessary, in order for the bromide salt to become colourless, that a longer exposure should be given. With respect to the iodide of silver, there are special conditions requisite, and I have only been able to cause this salt to blacken in the sun after having sensitised it by means of pyrogallic acid. It does not blacken visibly without a reducing agent. It would be especially interesting to know if the cyanide of silver would behave in a similar manner in the presence of cyanogen; but I have not had time to make this experiment, but I hope to be able to record it at another meeting of the Association.

THE MEASUREMENT OF GASES OVER WATER.

By PHILIP HOLLAND.

In a short article on this subject, which appeared in the Chemical News for July 3, I proposed the adoption of Erdmann's float to be used with the graduated tube when reading off a volume of gas over water. The chief advantage claimed for it is that the operator is enabled readily to appreciate differences of a tenth of a cubic centimetre when obliged to use a moderately wide tube.

At the time the article appeared I was about to leave for the Continent, and was unable to give any confirmatory experiments; I therefore take the present opportunity of supplying them. Since the use of the float requires that the measuring tube shall contain a short column of air or other gas, in order that the float may assume its equilibrium, it is scarcely necessary to add that its service is limited to the volumetric determination of those gases which do not require further treatment by reagents.

In my former communication I alluded to Dumas's method for the absolute determination of nitrogen, and singled out that gas as one to which the method then proposed could be easily applied.

In the experiments given below I have repeated, by way of illustration, one originally made by Wanklyn and Chapman, who showed, in a paper read before the Society in the early[*] part of the year 1866, that the hydrogen evolved by magnesium undergoing solution in dilute acid could be satisfactorily measured over water; and from the weight of the gas produced could be computed the percentage of real metal in the sample (Mg = 12 H = 1). The graduated tube which served me in the following experiments was divided in fractions of a cubic centimetre, the volumes and weights corresponding to the marks being determined by successive cautious additions of a volume of distilled water at 16°, the weight of which had been carefully ascertained. The calibration was conducted as follows:—Into the inverted tube was put, by means of a pipette with a long stem, sufficient distilled water to reach a division of the scale. The pipette contained about 5 cubic centimetres. I next determined the weight of the water it was capable of delivering in a given length of time. At the end of twenty seconds it was free of all water which would leave it by running; droppings were not collected. The mean of ten weighings of this volume of water at 16° C., in grammes delivered in twenty seconds, was taken as the standard in the calibration. The readings were made by aid of a small telescope, the lowest level of the dark zone being considered[†] as the level of the water-column in the tube. The solution of the metal was effected in a small flask fitted with a caoutchouc stopper carrying a delivery-tube and small tap-funnel. The whole arrangement was filled with spring water before the evolution of gas took place, the acid being afterwards added by means of the funnel.

No. I.

Magnesium ·1005 grms.
Temperature 11° C.
Barometer 753·4 m.m.
1st reading, corrected from table 10·43 c.c.
2nd „ „ „ 109·31 „
Difference 98·88 c.c.
= 96·74 (dry) at 11° C., 760 Bar.
= 93· „ 0° C., 760 „
= ·008333 grm. hydrogen
= per cent, 8·291
100 pts. of magnesium give 8·333 per cent.

No. II.

Magnesium ·169 grm.
Temperature 11° C.
Barometer 751·8 m.m.
1st reading 10· c.c.
2nd „ 179· „
Difference 169· c.c.
= 158·6 (dry) at 0° C., and 760· Bar.
= ·014212 grm. hydrogen
= per cent, 8·408

No. III.

The following experiments were made with commercial granulated zinc:—

Zinc ·12325
Temperature 10·4° C.
Barometer 747· m.m.
1st reading, 14·21
2nd „ 58·84
Difference 44·63
= 41·72 c.c. at 0°, and 760 Bar.
= ·003738 hydrogen
= per cent, 3·032
100 pts. of zinc give 3·0769.

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[*] The paper appeared in the May or June number of the Chemical Society's Journal.

[†] A piece of thin paper should be placed behind the tube when making these observations.

No. IV.

Zinc ·13575
Temperature 10·2 C.
Barometer 752·4
1st reading, 12·3
2nd „ 61·17
Difference 48·87
= 46·05 at 0°, and 760 Bar.
= ·004126 grm. hydrogen
= per cent, 3·039.

No. V.

Zinc ·212
Temperature 11·8
Barometer 751·5
1st reading 17·1
2nd „ 94·1
Difference 77· c.c.
= 71·98 at 0° at C., 760 Bar.
= ·006452 grm. hydrogen
= per cent, 3·043.

The above experiments were not all made on the same day, as the different readings of the barometer testify. The accordance of the numbers obtained is, perhaps, as great as could be expected, when we reflect that hydrogen is not altogether insoluble in water, and, moreover, that the method adopted for calibrating the tube was not one having any special claim to precision, though its object was to afford a relation between the brass weights and the volume marks of the tube.

Chorley, Lancashire.

NOTE ON THE

DETECTION OF PHOSPHATE OF LIME IN SUBNITRATE OF BISMUTH.

By Dr. REDWOOD.

In a brief notice I gave in the last number of the *Pharmaceutical Journal* of the "Adulteration of Subnitrate of Bismuth with Phosphate of Lime," I alluded to a test recently published by Mr. Roussin. I am informed by Messrs. Howard and Sons, of Stratford, that they have found this test fallacious, as continued boiling causes a precipitate of bismuth itself when no phosphate is present. They suggest the following modification of the test, by which they say one-third of a grain of phosphate of lime is easily detected:—

"To one part of the salt of bismuth dissolved in weak nitric acid add two parts of citric acid; dissolve with the aid of a little water; add an excess of solution of ammonia, and boil. Any phosphate present will be thrown down with continuous boiling of the solution." Although absence from home prevents my adding my own experience on the subject, I am anxious, on the unquestionable authority of Messrs. Howard, at once to guard those who may have been induced to use Mr. Roussin's test against the erroneous conclusions to which it appears it may lead. In the cases referred to in my former note, I had obtained evidence of the adulteration indicated by other and perfectly trustworthy means before my attention was directed to Mr. Roussin's test.—*Pharmaceutical Journal.*

Disinfection of Streets and Confined Places.—Dr. Whitmore has ordered periodical watering of streets, courts, alleys, and confined places in Marylebone, with disinfecting liquid during the last six weeks. In Paddington, both carbolic acid and Condy's liquid have been lately used for deodorising the sewers and gullies.—*British Medical Journal.*

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Continued from page 82.)

Varieties of Food—their Chemical Composition and Nutritive Value.

Maize, or *Indian Corn*, is one of the most extensively used grains in the world. It enters largely into the food of the inhabitants of America, Italy, Corsica, Spain, the South of France, and the Danubian Principalities. Since the famine in Ireland, it has there also become a common article of diet, especially when potatoes are dear; but its flavour is harsh and peculiar, and nothing but a scarcity of more agreeable food reconciles people to its use. The young grain called cob is, however, more palatable, and forms, when boiled in milk, an American luxury which takes the place of green peas.

The farina is peculiar when examined under the microscope, and will thus serve to recognise it.

Although the meal is rich in nitrogenous matter and fat, it does not make good bread. It is, therefore, either cooked by baking it into cakes, or by stirring it into boiling water or boiling milk, as in the case of oatmeal, and thus making a sort of hasty-pudding or thick porridge. This is the method of using it in Ireland, and it is flavoured with salt, or butter, or treacle. The favourite mess, called corn-lob by the Creoles of British Honduras, is prepared with milk in the same way. Indian meal mixed with maple sugar, and baked into cakes, formed, at one time, the chief article of diet of the almost extinct Delaware Indians.

When deprived of its gluten, and harsh flavour, by means of a weak solution of caustic soda, and then dried, it forms the expensive food called Oswego or corn flour, which is now largely used for puddings.

Lastly, it is often mixed with wheaten-flour and baked into bread, but its harsh taste is never completely covered.

The grain is said to cause disease when eaten for a long time and without other meal—the symptoms being a scaly eruption upon the hands, great prostration of the vital powers, and death after a year or so, with extreme emaciation. These effects have been frequently observed among the peasants of Italy, who use the meal as their chief food, but I am not aware of any such effects having been seen in Ireland, where it is often the only article of diet.

The nutritive power of Indian meal is very high, and, considering its price, it is almost, if not altogether, the cheapest food for the poor. Calculated according to the physiological wants of the system, a week's diet for an adult will only cost about 10½d., and excepting split peas, which are of doubtful digestibility, there is nothing approaching it for economy.

Rice is the principal food of eastern and southern nations. It is extensively cultivated in India, China, South America, and the southern countries of Europe; and it gives nourishment to not less than a hundred millions of persons. In this country, however, it is rarely employed, except as an adjunct to other foods. Now and then, in times of scarcity, it is used in the place of potatoes. Perhaps 50 per cent of our labouring classes use it in this manner. It is imported into this country in a decorticated or cleaned condition, but when it has the husk upon it it is called paddy. The kinds which are most esteemed in this country are Carolina and Patna; but, according to Dr. Watson, there are many Indian varieties which are nearly equal to the American. The proportion of gluten in it is only about 6·3 per cent, and it rarely exceeds 7. It is, in fact, one of the least nitrogenous of all the cereals, and cannot be made into bread unless it is mixed with wheaten-flour, as is the custom in Paris in making the best white bread. The proportion of nitrogenous to carbonaceous matter is as 1 to 12·7, or nearly twice the amount in wheat. It is, therefore, a good adjunct to highly plastic foods, as ox-liver, poultry, veal, and fish, with all of which it goes well, especially in the savoury form of curry. Boiled with milk also, and dressed with egg, as rice pudding, it forms a substantial meal; but in no country is it eaten alone.

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* The Cantor Lectures, delivered before the Society of Arts.

The *Millets*, called also *Dhurra* or *Dhoora*, are another kind of grain, and are derived from many species of plants, as *sorghum*, *penicellaria*, *panicum*, &c. Like rice, they are extensively cultivated in India, Egypt, and the interior of Africa, where they are important articles of diet. They are a little more nutritious than rice: for they contain, on an average, about 9 per cent of nitrogenous matter, with 74 of starch and sugar, 2·6 of fat, and 2·3 of mineral matter. We have no experience of their nutritive properties in this country, except in feeding birds; but in India the grains are ground whole and made into bread.

The last of the grains of any importance is *Quinoa*, a species of *chenopodium*. It is hardly known in this country, although it is extensively cultivated and consumed on the high table-lands of Chili and Peru. Mr. Johnston has described it, and he says there are two varieties of it —the sweet and bitter—both of which grow at an elevation of 13,000 feet above the level of the sea, where barley and rye refuse to ripen. It is very nutritious, and approaches oatmeal in its chemical composition, the amount of gluten being about 19 per cent, the starch and sugar 60 per cent, and the fat 5.

The next class of farinaceous foods are the *pulses*, as peas, beans, and lentils of this country, and the dholls and grams of India. They are grown and eaten in all parts of the world, and are everywhere regarded as very nutritious when they can be digested. Nothing, however, but the most prolonged cooking will serve to help in this particular. As will be seen by reference to the tables, where the composition of peas, the type of all of them, is given, they are rich in nitrogenous matter, for peas and beans contain about 23 per cent, and lentils about 25; but the carbonaceous constituents amount to only 59 per cent, or 1 to 2½. They are therefore, when eaten, invariably associated with fat. In India, the favourite pea (*cajanus Indicus*) is rubbed with oil before it is cooked. In Yucatan, and throughout the whole of Central America, where black beans, called frijoles, are extensively used as food, they are well boiled in water, and eaten with pepper, salt, and pork. In this country, butter with peas, and fat bacon with beans, are inseparable companions. Lastly, revalenta or ground lentils with cocoa, which contains over 50 per cent of fat, are mixed in a well-known fancy preparation. The nitrogenous matter of the pulses is not of the nature of gluten, but is more like casein, or the cheesy matter of milk, and it was named by Braconnot, its discoverer, legumine.

Other farinaceous foods, of little importance to us, are the meal of the *edible chesnut*, which is largely used by the peasants of Lombardy; the *Manioc* and *Lotsa meal*, which, Dr. Livingstone says, are the chief vegetable foods of the natives of some parts of South Africa; perhaps, also, the *horse-chesnut* and the *acorn* might be added to the list, for there is hope of their being easily freed from the bitter principle which now renders them useless.

And last of this class of foods are the *starches* and *arrow-roots*, which are largely imported or prepared in this country. They are Bermuda, Jamaica, or West Indian arrow-roots, from *maranta arundinacea*; East Indian arrowroot, from various species of *curcuma*; *Tous-les-mois*, from *canna*; Brazilian arrowroot, from *jatropha manihot*, which, when dried and partially cooked on hot plates, makes tapioca; and which, when baked in its whole condition, forms cassava bread; sago and sago-meal, from the fruit of various species of *sagus*; Tahiti arrowroot, from a *tacca*; Portland arrowroot, from the tubers of an *arum*; and English arrowroot from potatoes. All these are obtained in the same way—namely, by crushing, or bruising, or rasping the root or other substance containing them, and after diffusing through water, allowing the starch or fæculoid matter to deposit; it is then collected on a cloth and dried. In this country, starches are obtained by soaking the grain in an alkaline liquor which dissolves the gluten, and then crushing between mills, straining to keep back the husk and cellulose, and then washing with water, and allowing the starch to subside. By this method of manufacture a quantity of gluten is obtained, which can be set free from the alkali by an acid and collected for food.

All the starches and arrowroots are known by their microscopic characters, and although they have the same chemical composition and nutritive value, yet they are very different in their digestibility, for the true arrowroots of the West Indies, as Bermuda and Jamaica, will often remain on the stomach of an invalid when the others will be rejected.

They contain no nitrogen, or but a trace of it, and therefore have no nitrogenous value, but they are useful for their carbonaceous properties; and they are best cooked by stirring them into boiling water or boiling milk, and then simmering for a minute or so.

The next class of vegetable foods are those which contain much water, and which may be called *succulent vegetable foods*, of which the potato is the most important.

Brought to us from America, in the seventeenth century, as a rarity, by Sir Walter Raleigh, it has gradually become an almost universal article of diet; for its advantages are so numerous that it will ever be a favourite food. It is, for example, easily cultivated, easily kept, easily cooked, and easily digested; besides which it requires but little flavouring matter, and never wearies the palate. It is therefore used in times of plenty by all classes of persons, and is often eaten in quantities that approach very nearly to the rice allowance of a hungry Hindoo. "In Ireland," says Dr. Edward Smith, "when the season arrives and potatoes are plentiful, as much as 3½ lbs. are consumed three times in a day by an adult. This, indeed, is the regular allowance, and an Irishman finds no difficulty in consuming his rations of 10½ lbs. of potatoes daily." In England, the farm labourer consumes, on an average, hardly as much in a week. In Anglesea, however, potatoes are eaten twice a day, and the consumption is about 16½ lbs. per adult weekly; and in Scotland the average allowance is 15 lbs. per head weekly.

The nutritive value of the potato is not great, for, in the first place, it contains only about 25 per cent of solid matter, and of this hardly 2·1 is nitrogenous. Potatoes are also deficient of fat, and therefore they require admixture with nourishing materials. They go well with meat and fish, and are considerably helped with a little dripping or butter; but the great adjunct is milk. In Ireland, potatoes and buttermilk are the principal diet, even in times of plenty.

Considering the cheapness of potatoes, they are a most economical food. At the price of a halfpenny a pound, as set down in table No. 4, it costs but two shillings and threepence a week to provide the carbon and nitrogen required by an adult; but when potatoes are cultivated upon cottage ground, by wife and children, as is the practice almost everywhere, as much as 7 lbs. can be easily obtained for a penny, and then the weekly diet would be rather less than eight-pence. At this price no vegetable food can compete with it.

Potatoes are best cooked in their skins, for the waste is then only about 3 per cent, or half an ounce in a pound; whereas, if they are peeled first, it is not less than 14 per cent, or from two to three ounces in a pound. The mealy varieties are more digestible than the close and waxy; in fact, when they are in this state, as is the case

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with new potatoes, and potatoes late in the season, which have begun to grow, they are best cooked by stewing them.

All succulent vegetables are endowed with anti-scorbutic powers, but potatoes are especially renowned for this property. As far back as the year 1781, Sir Gilbert Blane, in his work on the "Diseases of the Fleet," alluded to the beneficial action of the potato in scurvy, and from that time to the present, its salutary powers had been repeatedly observed. The late Dr. Baly remarked, in his inquiries into the diseases of prisoners, that wherever potatoes were used scurvy was unknown; and it is the almost universal practice now to carry potatoes, fresh or preserved, in all ocean-going vessels, with the view of preventing scurvy.

Other succulent vegetables in common use, as turnips, parsnips, carrots, artichokes, onions, leeks, cauliflower, cabbages, and greens, have, among themselves, nearly the same nutritive value, but they are all much less nutritious than the potato, as will be seen by reference to the table No. 3; in fact, they do not contain more than from 9 to 17 per cent of solid matter, and of this only about 1·2 is nitrogenous. They are chiefly valuable for their anti-scorbutic properties, and for their quality of flavouring insipid food and diluting strong ones.

Banana and *bread-fruit* are also valuable esculent foods, and are largely used in the tropics. The former contains about 27 per cent of solid matter, of nearly the same nutritive value as rice. About 6½ lbs. of the fresh fruit, or 2 lbs. of the dry meal, with a quarter of a pound of salt meat or fish, is a common allowance for a labourer. The bread-fruit is largely eaten by the natives of the Indian Archipelago and of the Islands of the South Sea. There are several varieties of it which come into season at different times. It is very juicy, containing about 80 per cent of water, and is generally gathered before it is ripe, when the starch is in a mealy condition, and has not undergone change into sugar. The fresh fruit is cooked, by peeling it, wrapping it in leaves, and baking it between hot stones. It then tastes like sweet bread; but much of the ripe fruit is preserved by peeling it, cutting it into slices, and packing it very closely in pits in the ground, made water-tight, and lined with banana leaves. After a while it undergoes a sort of fermentation, or, as we should call it from the smell, putrefaction, and the fruit settles into a mass, of the consistence of soft cheese. When it is required for use, it is well kneaded, wrapped in leaves, and baked, like the fresh fruit, between hot stones.

Ripe fruits, as apples, pears, peaches, pine-apples, oranges, &c., are not of much nutritive value for they rarely contain above 13 per cent of solid matter, and this is of no more value than so much rice, but they have agreeable flavours, and serve the purpose of anti-scorbutic drinks.

Marine Algæ.—Everywhere along our coasts, there is abundance of comparatively nutritious food, which may, by a little management, be made palatable. I allude to our sea-weeds; and this Society has distinguished itself by its efforts to utilise this stock of now almost profitless food. Judging from the analysis of Dr. Davy and Dr. Apjohn, of Dublin, it would seem that when in a moderately dry condition sea-weeds contain from 18 to 26 per cent of water; and that the nitrogenous constituents amount to from 9½ to 15 per cent, while the starchy matter and sugar average about 66 per cent. These results place sea-weeds among the most nutritious of vegetable substances; in fact, they are richer in nitrogenous matter than oatmeal or Indian corn.

The varieties of sea-weed at present used are the following:—

Porphyra laciniata and *vulgaris*, called laver in England, stoke in Ireland, and slouk in Scotland.

Chondrus crispus, called carrageen or Irish moss, and also pearl-moss.

Laminaria digitata, known as sea girdle in England, tangle in Scotland, and red-ware in the Orkneys; and *laminaria saccharina alaria esculenta*, or bladder-lock, called also hen-ware and honey-ware by the Scotch.

Ulva latissima, or green laver.—*Rhodomenia palmata*, or dulse of Scotland.—These, with many others, are eaten by the coast inhabitants of this country and the Continent. In some parts of Scotland and Ireland they form a considerable portion of the diet of the poor.

To prepare them for food, they should first be steeped in water to remove saline matter; and in some cases a little carbonate of soda added to the water will remove the bitterness. They are then stewed in water or milk until they are tender and mucilaginous; and they are best flavoured with pepper and vinegar. Under the name of marine sauce, the lavers were once a luxury in London.

As to the last of the vegetable foods—namely, the *fungi* or *mushrooms*—I have but little to say; for although the edible varieties are highly nutritious, yet they can never become an important article of diet. Most of them are employed at the present time as flavouring agents; and among these are the common mushroom for ketchup, the morel for gravies, and the truffle for turkeys and the livers of geese (*Pâté de foie gras*).

Sugar and *Treacle*.—Both of these are very generally consumed on account of their flavouring and fattening qualities. Dr. Edward Smith found that 98 per cent of indoor operatives partook of sugar, to the extent of 7¼ ozs. per adult, weekly. 96 per cent of Scotch labourers use it, and 80 per cent of Irish. In Wales, also, it is commonly used to an average extent of 6 ozs. per adult weekly; but there is a marked difference in the rate of consumption in the northern and southern portions of the country. In North Wales, for example, the average amount per head is 11¼ ozs.; whereas, in South Wales it is only 3 ozs. The principal use of it is to sweeten tea.

Treacle has more flavour than sugar, and it is also cheaper. It is, therefore, more largely employed; and that description of it properly called molasses, which is the draining from the raw or unrefined sugar—treacle being the drainings from refined sugar—is preferred on account of its stronger flavour, and is most usually sold for treacle. They go well with all descriptions of farinaceous food, as porridge, pudding, dumpling, and bread.

Sugar contains from 4 to 10 per cent of moisture, and treacle about 23. The rest is carbonaceous matter, without nitrogen. They are, therefore, heat-producing and fattening agents, and their power, in these respects, is about the same as with starch. Whether they can produce disease when used in excess is a matter of doubt; but Dr. Richardson declares that they cause blindness by creating opacity of the lens (*cataract*).

(To be continued.)

ON ACTINOMETRY.*

By LOUIS BING.

HAVING made a few experiments for the purpose of ascertaining the actinic power of light, which I considered might not be uninteresting to science, I beg to submit the following communication to your notice:—

Permit me, in the first instance, to speak briefly of an instrument of my construction for actinometric purposes, which is already known. It consists of layers of mica, and upon each number of layers of mica is placed a figure corresponding with such number by means of an opaque pigment. This instrument, being charged with sensitive paper and exposed to the action of light, yields a graduated series of tints upon such paper, presenting white figures surrounded by darkened surfaces. The highest visible figure is always surrounded by the palest tint.

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* British Association, Norwich Meeting, Section A.

This instrument has, however, several defects, the chief of which is, that according to the varying intensities of light, its action will vary, as will be explained by the following experiment :—

You might come to the conclusion that, if the intensity of light transmitted through one layer of mica be equal to one, the intensity transmitted through two layers equal one-fourth, through three layers equal one-ninth, &c.; or that the intensities transmitted vary inversely as the squares of the numbers of layers of mica. It does, however, by no means appear that actinism is transmitted through a medium in the same harmonic progression.

From a rather thin negative print a positive firstly in the direct rays of the sun, exposing also at the same time a mica actinometer charged with sensitive standard paper to the direct rays of the sun. Examine the positive picture from time to time in a so-called photographic dark room, or in any room lighted artificially by a non-actinic light, but remove also, or screen from the light, the actinometer during the time of the examination of the positive. When you consider the positive so far printed as to be fit for photographic toning, remove the papers both from the negative and from the actinometer, and write with a pencil upon the back of the one taken from the latter the word "sun."

Next print a positive from the same negative in diffused light in the open air, exposing at the same time the actinometer, charged anew, to the same light. Pursue the same course as before, and examine your positive from time to time in the dark room, having the first positive at hand for comparison with the second. It is best to fix upon some dark, yet not black, tint in your first picture for comparison with the second; also to hold the first picture by the side of the half of the second picture which you are examining in your printing-frame. Thus make frequent comparisons with the tint you have fixed upon until the two tints appear to be alike in depth of printing. Then remove again the papers from the negative and from the actinometer, and upon the one taken from the latter write the word "shade."

Print now a third positive from the same negative inside a window where daylight is but feebly diffused, exposing again simultaneously the newly-charged actinometer by the side of the negative. Pursue again the same plan as before. After this third positive has been found to be printed equally deep as the two former, place the three papers which have been printed under the actinometer side by side for examination in your dark room.

The paper which has been printed in the direct rays of the sun will present the largest number of figures; next comes that which has been printed by diffused light in the open air, and the least number of figures will appear upon the paper printed inside the window, although the three pictures might be pronounced alike.

The positives would, however, appear not to be quite equal in tone on a more exact examination of the extreme tints in each picture with one another. The inequality would consist in this:—The positive printed in the feeblest light presents the deepest tint in the darkest shades, and the palest tints in the lightest parts. Next comes the positive which has been printed in the more bright diffused light, and the positive printed in the direct rays of the sun exhibits the least contrast between its palest and darkest tints; and its darkest tints, compared with the darkest tints in the other two positives, presents the least depth, just as its palest tint, compared with the palest tints in the other two positives, is decidedly the darkest of the three. Indeed, it does not seem possible to print three positives, in three lights of strongly-varying intensities to be exactly alike in all their tints.

If you examine now the tints, instead of the figures in the three papers printed under the actinometer, they agree with the results presented in the pictures. The first tint of the paper printed in the feeblest light, which paper shows the smallest number of figures, is the darkest. Next in order comes that which was exposed to the next brightest light; and the first tint of the paper that was exposed to the direct rays of the sun, and which exhibits the largest number of figures, is the palest on comparison with the first tints of the other two papers.

I once constructed an actinometer of only seven figures by means of a rather opaque medium. In the direct rays of the sun the printing of a positive from a certain negative required No. 5. In a diffused light in the open air, whilst the sun was shining, a positive from the same negative required only No. 3; and printing one dull winter's day from the same negative, and under the same actinometer, the positive was finished, and not the faintest trace of a figure presented itself upon the paper taken from the actinometer. The margins of the paper projecting beyond the actinometer had arrived at the stage of strong bronzing.

This instrument would thus appear to possess but small value, both for the scientific measurement of the actinic power of light as well as for photographic purposes. It almost seems as if it had no other value but that of verifying a fact with which most photographers are familiar, namely, that in order to produce good positives from thin negatives they ought to be printed in feebly-diffused light, because the feebler light will readily act through the more transparent parts of the negative and but very slowly through the semi-opaque parts, thus yielding good contrasts between the tints of the picture; and in accordance with this fact, the feebler light acts readily through the first few layers of mica, until, after passing through a certain number of layers, it seems to possess but very slow power to affect the sensitive paper.

I hope, however, to show presently some important uses to which this instrument can be applied, and would now beg to describe another instrument of my construction.

This instrument consists of a single tube, open at one end, where light for measurement is admitted, and closed at the other. This tube is constructed of three strips of yellow non-actinic glass, and the fourth side of the tube, where sensitive paper is applied, may either consist of a strip of pure glass, with a scale marked thereon, or of a narrow scale made of metal or any other material, in which case light affects the sensitive paper quite freely.

In this state the instrument can only be used for the measurement of the actinic power of diffused light. By applying, however, a small convex mirror or a small lens at the aperture of the instrument, the direct rays of the sun can also be measured, on being received in a divergent direction within the tube. The action of light upon sensitive paper is here seen through the yellow non-actinic glass, and it can be watched without removal of the instrument or of the sensitive paper therefrom. The action of light can also at any moment be stopped, without removal of the instrument, by shutting the aperture with an opaque shutter, and thus excluding actinic light.

The principles upon which this instrument are founded are—

1st. That diffused light on entering a tube at one end only, varies in intensity within the tube inversely as the square of the distances from the aperture where light enters.

2nd. That any number of tubes, whatever their magnitude, contain the same intensity of light if the ratios of their diameters to their lengths are equal, and if we absorb the light that may be reflected from their sides.

I would now beg to call your attention to the following experiments :—

Construct a series of tubes of cardboard, open at one end and provided with a cover at the other, of the same diameter—say of two inches—and varying in length by a semi-diameter. Let the first tube be of two inches length, the second = three inches, the third = four inches, up to ten inches, or more, if you like; but these nine tubes will suffice. The inside of the tubes must be blackened, in order to absorb the light that would otherwise be reflected from their sides.

Next construct a number of small mica-actinometers of twenty or thirty figures, and of such dimensions that they can be placed within those tubes. For the sake of convenience, let each actinometer have a letter of the alphabet whereby to name it placed upon its first layer of mica instead of figure 1. Charge each instrument with a strip of sensitive standard paper, and insert one at the base within each tube, and secure each base against the entrance of light from without. Let the actinometer named A be situated at the base of the shortest tube of 2 inches, B in that of 3 inches, C in that of 4 inches, &c., each succeeding letter in the next longer tube.

Expose now all the tubes, which are open at the ends opposite their bases, simultaneously to the same diffused daylight, five, ten, or fifteen minutes, more or less; then take all the tubes at the same time into your dark room. Withdraw the actinometers from the tubes, and the papers from the actinometer.

Please to remember now that each letter of the alphabet will be surrounded by the darkest tint upon the paper removed from the actinometer which such letter represents, because such letter is placed upon the first layer of mica, and let now each paper also be named by such letter.

On comparing the papers with one another, the following results will appear:—

1. Compare with paper A, which was printed within the shortest tube, all the other papers.

The tint around letter B = the tint around No. 3 of paper A.
" " " C = " " " 5 "
" " " D = " " " 7 "

Thus, through the whole series, the tint around each succeeding letter printed within the corresponding longer tube is paler by two tints.

2. Take any paper of the series, say paper D, and compare the following papers with it:—

The tint around letter E = the tint around No. 3 of paper D.
" " " F = " " " 5 "
" " " G = " " " 7 "

&c., as before.

3. Compare the papers successively with one another:—

The tint around letter B = the tint around No. 3 of paper A.
" " " C = " " " 3 " B.
" " " D = " " " 3 " C.

each first tint equalling the third tint of the paper printed in the next preceding shorter tube.

4. Compare all the figures which each paper presents with one another. Let, for instance, paper A show twenty-five figures:—

Paper A shows 25 figures,
Then " B " 23 "
" C " 21 "
" D " 19 "

each succeeding paper printed within the next succeeding longer tube exhibiting two figures less than the preceding one.

The defect which has in a former part of this memoir been shown to exist in the transmission of the actinic power of light through a medium ought to become apparent in the above experiment. On account of the comparative shortness of exposure given, it only can be traced to a small extent in the fourth comparison of the papers. This does not, however, affect the general character of the experiment.

We may now draw from the above experiment the general conclusion that there is a decrease of two figures and of two tints in each succeeding paper, beginning with that which was printed within the shortest tube. Or, if the paper printed within the longest tube be represented by 1, the paper taken from the next shortest tube would equal 3, and, thus continuing, we shall have the numbers 1, 3, 5, 7, &c. On adding these figures from the beginning we produce the following series;—4, 9, 16, 25, &c., equalling the squares of the lengths of the tubes.

Without further analyses of the above experiment, I think it may be stated now that the power of actinism, as well as the intensity of light, within a tube varies inversely as the squares of the distances.

Construct next two tubes, blackened within, of different diameters, and let the length of each tube be equal to, say, twice its diameter. Let one tube have a diameter, say, of 2 inches, and the other of 6 inches; then their respective lengths must be equal to 4 inches and 12 inches. Place at the base within each tube a mica actinometer charged with sensitive standard paper. Close each base, and expose both tubes simultaneously to the same diffused light for the same period of time. On examining the printed papers no difference whatever is exhibited in their appearance, either with regard to tint or to number of figures. You might make several such experiments, with any number of tubes of various diameters, and with the same results.

Thus the intensity of light as well as the power of actinism is the same in tubes of various magnitudes, if the ratios of their diameters to their lengths are equal.

It will be readily seen that instruments might be constructed by means of tubes of various lengths but of equal diameters, or by means of tubes varying in diameter and of equal length, in order to produce gradations of light for actinometric purposes.

On account of its greater convenience I have, however, chosen the single square tube, and of such tube one side, as already stated.

The power of actinism and the intensity of light at any given distance on this side of the tube are, however, by no means equal to the power of actinism and the intensity of light at such given distance within the tube. But the investigation of the powers of this side light would be too lengthy for this paper.

I beg, finally, to state that, for scientific purposes, I use a tube 1 inch in width and 4 inches in length. For photographic purposes, such as the timing of photographic prints, I use a tube of half-an-inch in width by 4 inches in length.

The instrument is self-registering, and, by means of a continuous strip of paper and simple clockwork, can be made to register the actinic power of light throughout the day, per minute or per hour, or any other chosen division of time.

By combining several instruments with one clockwork, the powers of actinism during each successive minute, successive hour, and during the whole day, could be registered separately.

FOREIGN SCIENCE.

Paris, Sept. 9, 1868.

The Sewage Question.—New Process for Preserving Wine.—New Researches on the action of Dry Hypochlorous Gas on a Mixture of Iodine and Acetic Anhydride.

The attention of the readers of the Chemical News has already been directed to the interest in the sewage question manifested here. M. Verstraet, in a long article published in the journal so ably conducted by M. L'Abbé Moigno—*Les Mondes*—reviews the subject and advances some new projects. The disinfection and removal of the refuse of Paris, and its subsequent treatment in the basins of Bondy, he says, have become a question of concern with the administration of the town. Paris complains, with reason, of the emanations which taint the atmosphere from ten at night to seven in the morning; the communities situated round Bondy exclaim against the fœtid atmosphere they breathe. These inconveniences in the present state of things occur (1) from the inability of the companies charged with the collection of the refuse to perform the far too heavy obligations imposed upon them; (2) from the fact that the disinfectants employed give only incomplete results. These disinfectants are metallic salts and principally protosulphate of iron; but the simple use of these salts can only remove the sulphide and carbonate of ammonium. Considering also the question in regard to agriculture, one finds that, owing to ignorant manufacture, more than three-fourths of the original matter is excluded in the manufactured manure. Three great points ought to be borne in view in a really rational process: (1) to destroy deleterious products, or rather to make them enter into new compounds insoluble in water, these products are hydrosulphuric acid and carbonic acid or their ammoniacal salts; (2) to render inodorous and inoffensive infectious products, miasmatic emanations of organic origin; (3) to eliminate such useless products as washing water, which tends to increase every day, by reason of the adoption of certain English arrangements in all recently constructed houses. The following is the process M. Verstraet employs to attain these conditions:—

1. *Decomposition of Sulphide and Carbonate of Ammonium.*—For this purpose the chlorides are employed, either of iron, zinc, or preferably manganese. As to sulphates, at present only employed, their use is absolutely proscribed, and for the reason that the putrefying matters react on the sulphate of ammonia formed by double decomposition, the final result being the evolution of sulphuretted hydrogen, so that after a little time it is necessary to disinfect a second time. The chloride of manganese proposed as a disinfectant would be obtained from the chlorine residues of manufactories, a product which is stated to be valueless. The residues contain too much hydrochloric acid to be immediately available; the acid is neutralised either by the oxides of iron or zinc, or by dolomite to which preference is given. By this saturation of hydrochloric acid with lime and magnesia, the value of the product as a manure is greatly enhanced. Experiments on a large scale showed the product to be very rich in nitrogen and in phosphoric acid, and the fluid after this treatment was found to contain no phosphoric acid. Manganese, as well as magnesia, has been demonstrated by the recent works of M. Peligot to be easily assimilated by plants. To render the action of the chloride of manganese still more efficacious, 5 litres of chloride of lime solution of 12° are added to 100 litres of the manganese solution.

2. *Suppression of Odours of Organic Origin and of all Subsequent Putrefaction.*—Notwithstanding the value of the disinfectant thus prepared, it is quite certain that metallic salts by themselves can affect no complete and permanent disinfection, no influence will be exerted upon the offensive odour, *sui generis*, of the refuse matter. The antiseptic agent introduced for this purpose is tar solidified by admixture of cinders, deprived of sulphur compounds by exposure to the air for fifteen or eighteen months. In this mixture are contained a considerable quantity of sulphate of alumina, 15 or 20 per cent of finely divided carbon, 50 or 60 per cent of nitrogen and protosulphate of iron, and silica in small quantity. In the place of the solidified tar, the heavy oil of tar residues have been employed with equal success. Lastly, to clarify the water, a solution of impure sulphate of alumina, employed in the dose of a kilogramme per cubic metre, has been found to give very remarkable results; this solution serves to clarify the liquid and to cause the deposition of the solid matter. One example of the practical results. A cesspool of 20 cubic metres in Rue des Jeuneurs was treated with 650 kilogrammes of manganese and 30 kilogrammes of chloride of lime liquid of 9°, then 180 kilogrammes of the aluminous powder with tar. After the liquid had been agitated and allowed half-an-hour's repose, it was clear and inodorous. The sanitary inspectors and other critics who witnessed the experiment testified that the matters were completely disinfected. After the liquid had been poured off into the sewer, the atmosphere of the receptacle was tested by the lowering of a light, after which two workmen descended, who found no other odour than a slight one of benzol.

M. Dumesnil has devised a new process for preserving wine; the process is not without other than commercial interest. The cask of wine uncorked is placed under an iron bell and the air exhausted; two hours' work is necessary before the noise occasioned by the exit of the air ceases. A vacuum being created the gases contained in the wine are released from atmospheric pressure, and as they are essentially elastic, they expand sufficiently to break the cells of vegetable fibrin enclosing them, and escape. These gases are dissolved to such an extent that the withdrawal of 30 or 40 litres of gas occasions no sensible decrease of liquid. The theory of the decomposition of grape juice and other organic substances rests on a very elementary fact, viz., on the power of double decomposition. Gaseous products of the fermentation do not remain inert, but energetically induce the fermentation or decomposition of free bodies. These products are the most active in inducing decomposition; they alter wines indefinitely when enclosed in the fibrin cells, which M. Pasteur calls mycodermes. White wines owe their great superiority in preservation over red wines, to their different condition as regards this point. M. Dumesnil gives an example of the practical value of his process. He allowed the wines of 1865 to ferment till March, 1866, so as to allow of the conversion of all the sugar and extractive matter into alcohol. At this period he substituted for the usual operations the treatment by the vacuum; fermentation ceased entirely. The wines thus treated arrived at their destination in good condition; with other samples treated in the usual way the result was very different. Notwithstanding four rackings, and possibly four clarifications, the wines have continued to ferment during the whole of the year 1866 and also the commencement of 1867, and they probably still contain gases which will affect them more slowly. M. Dumesnil mentions that his wines of 1867, treated in last March by the vacuum, yielded twice as much gas as those of 1865.

The following is an abstract of a memoir presented to the Academy a short time back, entitled "New researches on the action of dry hypochlorous gas on a mixture of iodine and acetic anhydride," by M. Schützenberger:—Former researches of M. Schützenberger showed that hypochlorous acid and acetic anhydride react upon each other to form a compound possessing the characters of an acetate, in which the metal is represented by chlorine. The reaction is in fact—

$$2(C_2H_3O)O + Cl_2O = 2(C_2H_3OClO).$$

The percentage composition and the whole of the properties of this body, particularly the action of metals, which liberate chlorine in the cold, with production of a metallic acetate, leave no doubt as to the constitution of this body, acetate of chlorine. Acetate of chlorine is decomposed in the cold by iodine, with disengagement of chlorine, a solid compound being formed; curiously, the substitution of the chlorine by iodine, instead of being in the proportion of their atomic weights, takes place by the substitution of one atom of iodine for three atoms of chlorine, and the solid product has the composition represented by the formula—

$$\left.\begin{matrix}3(C_2H_3O)\\ I'''\end{matrix}\right\}O_3, \text{ and not by } \left.\begin{matrix}C_2H_3O\\ I'\end{matrix}\right\}O$$

The iodine acts as a triatomic element capable of fixing three atoms of oxacetyl, just as it can fix three atoms of chlorine in the trichloride of iodine, $I'''Cl_3$. M. Schützenberger has prepared what he terms triacetic iodal, by passing a current of dry hypochlorous acid into acetic anhydride holding iodine in suspension, cooling the mixture with water; at the end of the operation yellow needle-shaped crystals are formed, their formation preceding that of the granular compound of triacetic iodal. The first crystals are formed in abundance about the moment when all the iodine is dissolved, and when the liquid is no longer orange-tinted. When two parts of acetic anhydride are taken for one part of iodine, the liquid becomes a solid mass. The crystals are easily purified by dissolving them, with the aid of heat, in acetic anhydride (at 60°); they are deposited in long yellow needles upon cooling; great difficulty is, however, found in completely isolating them from the mother liquor in a fit state for analysis. Diacetochloride of iodal is produced according to the equation—

$$(C_2H_2O)_2O + I + Cl_2O = I(C_2H_3O_2)_2Cl + Cl.$$

During its formation, the disappearance of the iodine and the evolution of chlorine are alone observed. An excess of hypochlorous acid in presence of acetic anhydride transforms it into triacetic iodal with brisk effervescence from chlorine—

$$2[I'''(C_2H_3O_2)_2Cl] + Cl_2O + (C_2H_3O)_2O = Cl_4 + 2[I'''(C_2H_3O_2)_3].$$

Water decomposes it instantaneously with production of acetic acid, hydrochloric acid, iodic acid, and chloride of iodine. Heated with acetic anhydride, it is decomposed towards 100°, yielding chloride of acetyl, iodacetic acid, a little free iodine, carbonic acid, and acetate of methyl.

A solution of triacetic iodal in acetic anhydride is acted upon in the cold by metals, such as copper, giving an acetate and a metallic iodide. Zinc ethyl acts energetically upon triacetic iodal, acetate of zinc, acetate of ethyl, and iodide of ethyl being formed. Tri-acetic iodal does not act upon benzol in the cold. If the mixture be heated in presence of an excess of benzol to a temperature not exceeding the boiling point of the hydrocarbon, the iodal is dissolved at first and may crystallise upon cooling, but gradually this effect disappears, and when crystals cease to be deposited upon cooling, one finds besides the benzol, (1) a liquid boiling between 180° and 190°, possessing the properties and composition of mono-iodised benzol, already obtained by the action of chloride of iodine upon benzoate of soda; (2) a solid body insoluble in water, soluble and crystallisable in alcohol. This substance has yielded 85·4 per cent of iodine; it appears to be a mixture of tetraiodised and quintiodised benzol. The decomposition at 100° of diacetochloride of iodal, in the presence of acetate anhydride, furnishes a rapid method of preparing iodacetic acid. This acid is still more easily obtained by following the method of M. Kekulé for the preparation of iodised benzols; the action is very lively and requires moderating. When sufficient iodic acid is employed, the liquid upon cooling becomes a solid mass of iodacetic acid, which is easily purified by dissolving in boiling benzol and crystallising.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Phosphorus a Reagent for Metals.—W. Schmid. When a solution of crystallised phosphorus in carbonic disulphide is shaken with water, a perfectly white precipitate is formed. The presence of traces of metals causes the precipitate to assume various colours. Thus solutions of copper are precipitated brown; those of silver, black; of mercury (oxide), yellowish brown; of gold, violet. The filtrates contain generally suboxides.—(*Zeitschr. Ch.*, N.F. iv., 161.)

Mercuric Naphtyle.—R. Otto and G. Möriës. Mercuric naphtyle is obtained by the action of sodium amalgam upon monobromnaphtalene according to the following equation:—

$$2(C_{10}H_7Br) + Na_2Hg = \left.\begin{matrix} C_{10}H_7 \\ C_{10}H_7 \end{matrix}\right\} Hg + 2NaBr.$$

The bromnaphtalene used in this reaction was prepared according to Glaser's method, *i.e.*, by acting with bromine upon naphtalene dissolved in carbonic disulphide, and subjecting the raw material to fractional distillation. Its boiling point was found at 277°—278° C.

Mercuric naphtyle crystallises in small white prisms of the rhombic system, is insoluble in water, sparingly soluble in boiling alcohol, cold benzol, or ether; readily soluble in hot carbonic disulphide and chloroform. It fuses at 243° C. When heated with soda-lime it decomposes in the following manner:—

$$(C_{10}H_7)_2Hg + H_2O = 2C_{10}H_8 + Hg,$$

but besides naphtalene a very small quantity of another hydrocarbon is formed, which seems to be dinaphtyle. Iod- brom- or chlorhydric acid decompose mercuric naphtyle into naphtalene and mercuric iodide, &c.

$$(C_{10}H_7)_2Hg + 2HI = HgI_2 + 2C_{10}H_8.$$

Iodine converts it at first into di-iodmercuric naphtyle (I), and then into iodnaphtalene and mercuric iodide (II):

$$\text{I. } (C_{10}H_7)_2Hg + 2J = (C_{10}H_7)_2HgJ_2.$$

$$\text{II. } (C_{10}H_7)_2HgJ_2 + 2J = (C_{10}H_7)_2J + HgJ_2.$$

The action of acetic acid gives rise to the formation of naphtalene and acetylmercuric oxynaphtyle:

$$(C_{10}H_7)_2Hg + C_2H_4\Theta_2 = \left.\begin{matrix} C_{10}H_7 \\ C_2H_3\Theta \end{matrix}\right\} Hg\Theta.$$

The latter crystallises in white needles, which are insoluble in water, readily soluble in hot glacial acetic acid, alcohol, carbonic disulphide, benzol, chloroform; less soluble in ether. It fuses at 154°. The authors intend to investigate the reaction between mercuric naphtyle and acetic ether, if such there be, with a view of obtaining ethylnaphtalene, and thus opening a way for the production of homologues of naphthalene.—(*Ibid.*, N.F. iv., 162.)

Conversion of Benzoic into Anthranilic Acid.—H. Hübner and A. Petermann. The action of bromine upon benzoic acid gives rise to the formation of only one monobrombenzoic acid, which fuses at 153° C. This acid may be successively converted into nitro-compound, β bromamidobenzoic acid (by treating the nitro-body with tin and chlorhydric acid), and an amidobenzoic acid, $C_6H_4(NH_2)COOH$, which is identical with anthranilic acid, by shaking the bromamido-acid with sodium amalgam. The acid thus obtained crystallises in long needles, which fuse at 144° C.; and its identity with anthranilic acid is conclusively proved by the fact that when treated with nitrous acid it produces a purple colouration with ferric chloride, a reaction which distinguishes salcylic acid from oxybenzoic and paraoxybenzoic acid (*Ibid*, N.F. iv., 205).

Isomers of Sulphocyanic Ethers.—A. W. Hofmann. If carbonic disulphide is added to an alcoholic solution of ethylamine, the solution becomes heated, and, on cooling, crystals of ethylsulphocarbaminate of ethylamine,

$$CS(NH.C_2H_5)S(NH_2.H.C_2H_5),$$

are separated. This salt fuses at 103° C., and is soluble in water and alcohol. The acid, when liberated by means of chlorhydric acid, is obtained in oily drops, which after a time solidify. On heating the salt to 110°—120°, hydric sulphide is set free, and the residue, after evaporation on the water-bath, solidifies to crystals of diethylsulphocarbamide or sulphuretted diethylurea—

$$CS(NHC_2H_5)S(NH_2.H.C_2H_5 = H_2S + CS.N(C_2H_5)_2NH_2.$$

This urea is readily soluble in alcohol, sparingly soluble in water, and fuses at 77° C. When distilled with phosphoric anhydride it gives off ethylic *sinapole*, (aethylsenföl).

$$CSN(C_2H_5)_2NH_2) = C_2H_5NH_2 + CSNC_2H_5.$$

Ethylic sinapole is isomeric with the etyhlic sulphocyanate which is obtained by heating potassic ethylsulphate with metallic sulphocyanate. Its boiling point is at 143°, being 12° higher than that of ethylic sulphocyanate. It combines with ammonia to ethylsulphocarbamide,

$$CS.N(H,C_2H_5)NH_2,$$

crystals, which fuse at 89°. Diethylsulphocarbamide as obtained by the action of ethylamine upon ethylic sinapole is identical with the compound from which ethylic sinapole is originally derived. Metbylethylsulphocarbamide, $CSN(C_2H_5.CH_3)NH_2$, is crystalline, and fuses at 54°. Ethylphenylsulphocarbamide,

$$CS.N(C_2H_5.C_6H_5)NH_2,$$

obtained by acting upon ethylic sinapole with aniline is isomeric with a compound derived from ethylamine and phenylic sinapole; the fusion point of the former is at 145°, that of the latter at 97°. Compounds analogous to those described have also been prepared from the methyl and amyle series.—(*Deut. Chem. Gesellsch., Berlin*, 1868, 25).

Oxamide from Cyanogen.—R. Schmitt and L. Glutz. If a current of cyanogen gas is passed into aqueous concentrated chlorhydric acid no change of colour takes place; the liquid when allowed to stand for twelve hours separates crystals of oxamide, the mother-liquor containing ammonic oxalate. Cyanogen and concentrated iodhydric acid likewise produce oxamide; a certain proportion of iodine is set free, and in solution are cyanhydric acid and ammonic iodide.—(*Ibid.*, 1868, 66).

CORRESPONDENCE.

SULPHOCYANIDE OF AMMONIUM.

To the Editor of the Chemical News.

Sir,—The letter inserted in your last number calls for a word of reply, since it is evident that Mr. Spence had not then seen more than an imperfect report of the paper to which he alludes.

Doubtless many members of the British Association will feel, like myself, the loss we have sustained by his absence from Section B., when my paper was read, as this unfortunate circumstance deprived us of the very valuable remarks which he has since undertaken, a little hastily, perhaps, to lay before your readers.

Mr. Peter Spence is "a good deal astonished" that I should have found samples of commercial so-called "sulphate of ammonia," which were nearly all sulphocyanide, and thinks it must have been "a very exceptional article,"

Perhaps he will be still more surprised when I inform him that it is *not* "an exceptional article," that samples representing many hundred tons of this particular product—I may state roughly some 800 to 1,000 tons perhaps—have been forwarded to my laboratory during the last five months by well-known houses in London and elsewhere. I thought it useful to call the attention of those interested in agriculture to the fact, that of this compound (valued by its nitrogen) only one-half the nitrogen is available for agricultural purposes.

Mr. Peter Spence thinks that "the chief matter of scientific interest in Dr. Phipson's paper is the mode by which he separates the sulphocyanogen compound."

I am sorry to differ from him in this respect. The portion of my paper which relates to the composition of the so-called sulphocyanogen, $C_8H_2N_4S_8O$, would appear, I doubt not, to any chemist, more important than that to which Mr. Spence alludes. However, in reply to his remarks, I wanted a method for estimating sulphocyanogen in a mixture of sulphate, chloride, and sulphocyanide of ammonium, and I found this method in the precipitation of the sulphocyanogen as a salt of copper, subsequently dried at 100°. The insolubility of this copper salt was known before Mr. Peter Spence was born, but I alone have shown that it can be used as an analytic method in the above circumstances. There was no allusion to any manufacturing preparation of sulphocyanide in my paper. The process which Mr. Spence mentions as having been patented by him, though somewhat ingenious, is far too costly. There is a very much more economical method for obtaining the whole of the sulphocyanide of ammonium from gas-liquor, well known in London if not in Manchester.

With regard to this subject I will trespass no more on your valuable space, since my paper, as read at the British Association, has now appeared in your columns, and, therefore, whatever may be said about it can easily be confirmed or refuted by referring to the paper itself.—I am, &c.

T. L. Phipson, PhD., F.C.S.

The Cedars, Putney, S.W.,
Sept. 8, 1868.

MISCELLANEOUS.

Strychnia in Beer.—The *British Medical Journal* of the 5th inst. contains the following most improbable statement. It is to be regretted that our contemporary did not give it on better authority than "It is said," or at all events did not publish the names of the several large brewers:—"It is said that several large brewers are experimenting on the properties of strychnia, with a view of testing how far it may be used safely in bitter ales."

Rectifying Alcohol by Means of Gelatine.—Whilst witnessing the manipulations of the Eburneum process in the studio of Mr. Burgess, at Norwich, Mr. Burgess mentioned a curious circumstance. When the gelatine and pigment forming the layer of eburneum is quite dry, it is coated with collodion to render it impervious to moisture. This operation he noticed always rendered the eburneum soft and limp, so that it required placing in the drying-box again. The greediness of the gelatine for moisture causes it to absorb the trace of water in the solvents of the collodion, and so become damp. This suggested to us a possible use for rectifying small quantities of alcohol, or removing water from collodion in which the use of imperfectly-rectified solvents has caused a tendency to give crapy films. Place a little pure gelatine in the spirit to be rectified. There is no danger of any portion of it dissolving, but it will absorb the water and gradually swell; it may then be removed, carrying the water with it. This will be found more convenient than the plan sometimes recommended of agitating with carbonate of potash, and after subsidence decanting.—*Photographic News*.

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2428. J. Scott, Sheffield, "Improvements in the preparation of food for horses, cattle, and other animals."—Petition recorded August 1, 1868.

2489. F. Walton, Staines, Middlesex, "Improvements in the treatment of resins or resinous gums, and in the application of the products obtained therefrom."—August 8, 1868.

2511. D. Hill, J. Richardson, Stockton-on-Tees, Durham, G. N. Duck, Coatham, near Redcar, Yorkshire, C. G. Johnson, Stockton-on-Tees, and W. F. Masterman, Aislaby Hall, near Whitby, Yorkshire, "Improvements in the manufacture of iron and steel."

2514. J. Thompson, Handsworth, Staffordshire, "Improvements in reducing and utilising certain descriptions of scrap homogeneous iron or steel."

2515. J. Broad, Arthur Street West, London, "Improvements in machinery, apparatus, and process in the treatment of carboniferous plants and other fibrous material for the manufacture of paper, cardboard, and other similar articles."

2517. C. D. J. Seitz, Bury, Lancashire, "Improvements in the construction of furnaces for the recovery of the soda from the waste lyes resulting from the boiling of esparto grass or straw in the working and incineration of the residue resulting from evaporation, and in an improved means of depriving it of any offensive odour."

2529. R. Sim, M.D., Naples, "Improvements in compositions for preventing the fouling of ships' bottoms and other buildings exposed to the action of sea or impure water."—August 12, 1868.

2540. H. K. York, Cardiff, "Improvements in treating cast iron and other metals, and in apparatus employed therein."—August 13 1868.

2541. H. B. Binko, Kingsland, Middlesex, "Improvements in the treatment and preparation of indigo for laundry and other like purposes."

2542. W. Shaen, Bedford Row, Middlesex, "Improvements in the manufacture of explosive compounds."—A communication from J. F. E. Schultze, Potsdam, Prussia.

2545. J. B. Thompson, Horton, near Slough, Bucks, "Improvements in coating iron and steel with gold, silver, and copper, and in apparatus for carrying out the same."—August 14, 1868.

2548. C. D. Abel, Southampton Buildings, Chancery Lane, "Improvements in the production of brown colouring matters for dyeing and printing."—A communication from J. G. A. Gros, Mulhouse, Haut Rhin, France.

2556. A. M. Clark, Chancery Lane, "Improvements in the manufacture of size."—A communication from T. Gray, Boulevart St. Martin, Paris.

2558. W. B. Espeut, Jamaica, "Improvements in curing, drying, and extracting molasses from sugar and other substances, and in apparatus employed therein."—August 15, 1868.

2560. A. Smith, Glasgow, N.B., "Improvements in the manufacture of sugar, and in apparatus therefor."—A communication from R. Smith, Demerara.—August 17, 1868.

NOTICES TO PROCEED.

1210. G. Clark, Northumberland Street, Strand, Middlesex, "Improvements in the manufacture and production of explosive compounds, and in apparatus for their manufacture and use."—Petition recorded April 11, 1868.

1240. R. Oxland, Compton Gifford, Plymouth, "Improvements in the treatment of ores and minerals containing copper, to extract copper therefrom."—April 15, 1868.

1251. J. Robinson, Deptford, Kent, "Improvements in the manufacture of paint."—April 16, 1868.

1341. J. Baggs, High Holborn, Middlesex, "Improvements in the manufacture of white lead, and in the use and application of certain machinery and apparatus for such purposes."—April 24, 1868.

1513. C. E. Brooman, Fleet Street London, "Improvements in preparing zirconia, and the employment of the same to develope the light of oxyhydrogen flame."—A communication from C. T. du Motay and Co., Paris, France.—May 8, 1868.

NOTES AND QUERIES.

Steatite.—Can any of your readers tell me the chief uses and market price of steatite (soapstone)?—W. T.

Testing Oak Bark, &c.—What is the best means of testing oak bark, valonia, &c., with a view to ascertain their relative value?—A. F. W.

Chemical Cement.—Can any of your readers tell me of a good cement that will resist the action of oil of vitriol, 175°. It is required to make the joints of a slate saturating cistern and drainer for manufacture of sulphate of ammonia?—Robin.

Bleaching and Dyeing Cotton.—A Subscriber in Clinton, Mass., U.S.A., wishes to enquire through our "Notes and Queries" for some practical method of bleaching cotton yarn in the cop, and also for the best receipt for dyeing a handsome "fast" green on cotton yarn.

Fireproof Dresses.—Can any of your correspondents give me sufficient practical instructions to enable me to promote the use of fireproof dresses, especially on the stage. I think if I could show the dancers that the matter could be easily and cheaply accomplished, without injury to the fabric or discolourment to its beauty, many might be induced to adopt means to secure themselves and the theatre from danger, and the public from irritating fears. Careful details will be required; also some hints as to price, with the best mode and place for procuring the chemicals?—Philip Sankey.

TO CORRESPONDENTS.

⁂ The Students' Number of the Chemical News will be published on Friday next, September 18th. Gentlemen holding official positions in the Universities, Medical Schools, &c., of the United Kingdom, where Chemistry forms a part of the education, who have not yet forwarded the necessary information to our office for publication in that number, will confer a favour by sending it with the least possible delay.

Thema.—Dr. Hofmann's "Exhibition Report" can only be procured second-hand; copies are very scarce.

A Young Chemist.—To find out the composition of the substance sent would require a careful chemical analysis.

O. P. X.—Fluoride of ammonium and hydrofluate of ammonia are identical. It is very difficult to obtain this salt quite pure. A mixture of fluor spar and sulphuric acid is genrrally employed for engraving and etching glass. The dull engraving is effected by exposing the glass to the vapour of hydrofluoric acid, whilst the bright engraving is produced by applying the liquid acid. A mixture of wax and a little turpentine is used to coat the glass.

G. Dickens.—Please repeat the question, we do not understand what you refer to when asking for "the publisher's name of the manufacturing chemists and the description of goods they make."

J. L. Panes.—The substance contains sulphur and barium, but how combined we cannot say without performing a full analysis.

An Aspirant.—You want a more elementary book than the one you name. Roscoe's "Chemistry" would be more suitable.

F. J. B.—See above answer.

Subscriber.—We do not know the composition of "the liquid called ethyl." Probably it is a trade name. If you require it in large quantities an advertisement to that effect would be most likely to give you information.

Communications have been received from A. P. Williamson; Dr. T. L. Phipson (with enclosure); L. Mond (with enclosure); G. Dickens; Otto Richter (with enclosure); T. A. Readwin; J. Panes; J. Bowing; C. R. Robinson; G. W. Weeks; E. Kernan; A. H. Allen (with enclosure); J. and W. Rickard; Dr. Dobell; B. Wheeler (with enclosure); R. Spice, Jun. (with enclosure); E. Beanes; J. Spiller (with enclosure); C. Blake; F. A. Abel, F.R.S. (with enclosure); R. Oertling; Dr. Russell; Dr. Röhrig; Dr. Struthers; Rev. B. W. Gibsone, M.A; Professor Wanklyn; J. H. Pepper; Professor Church, M.A.; E. Smith; Dr. Muspratt; and Dr. Attfield (with enclosure).

BOOKS RECEIVED.

Elementary Treatise on Physics, Experimental and Applied. Translated and edited from Ganot's Eléments de Physique. 3rd edition, revised and enlarged. By E. Atkinson, Ph.D., F.C.S. London: Longmans.

Esposizione di Saggi Dell Industria Nazionale Italiana. Per G. Arnaudon.

Dei Legni di Amaranto. Per G. Arnaudon.

E. Sue Applicazioni nell' Industria. Per G. Arnaudon.

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Chemical Technology, by Dr. Thomas Richardson and Henry Watts, Esq., F.R.S., &c. Part V.

Contents.—Prussiate of Potash, Oxalic Acid, Tartaric Acid, and the Tartrates of Potash, Citric Acid.

Appendix A containing additional information on Sulphur, Sulphuric Acid, Bisulphide of Carbon, Chloride of Sodium, Soda, Hydrochloric Acid, Potash, Soap, Glycerin, Aluminium and Sodium, Magnesium, Soluble Stannates, Arseniate of Soda, Silicates of Potash and Soda, Chlorate of Potash, Phosphorus, Lucifer Matches, Hyposulphite of Soda, Boracic Acid, Soluble Phosphates, Nitrate of Soda, Gunpowder, Gun-cotton, Nitroglycerine, and Prussiate of Potash.

Appendix B, containing Abstracts of Specifications of Patents relating to the materials and processes described in this and previous volumes.

Appendix C, Tables connected with these processes.

Appendix D, a Collection of Documents on Patent Rights.

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THE CHEMICAL NEWS.

Vol. XVIII. No. 459.

NOTE ON THE

POSSIBILITY OF DETERMINING THE AGE OF A SANDSTONE

BY

CHEMICAL ANALYSIS,

By Dr. T. L. PHIPSON, F.C.S.

A paper upon this subject was announced to be read by the author in Section C, but, at his own request, it is held over till next year, in order that a greater number of analyses of sandstones may be brought forward in support of his views.

The examination of certain specimens of red sandstones belonging to different geological formations (such as old red sandstone from Hellensburg, new red from Carlisle and Withwick, near Wolverhampton, &c.), led him to believe that it may be possible to determine the particular strata to which a sandstone belongs, by ascertaining the nature and proportions of the substances which it yields to boiling hydrochloric acid.

A few analyses of various English sandstones which the author has made appear to show that:—

1. Tertiary sandstones yield to the acid principally lime and peroxide of iron.
2. New red sandstones will yield peroxide of iron, lime, and magnesia, and the latter will be found almost invariably in the proportions necessary to constitute dolomite.
3. The sandstones of the coal measures give to the hydrochloric acid a very notable amount of protoxide of iron and some manganese, as well as lime and magnesia.
4. The old red sandstones give peroxide of iron, lime, and magnesia, but the lime is in excess, and not in the proportion to form dolomite.
5. In the older sandstones, talc, or silicate of magnesia appears, with or without the ingredients above named.

ON THE ELECTRO-DEPOSITION OF IRON.

The following letter from M. Klein to M. Jacobi will be read with interest:—

During my stay in Paris last summer, you wished to draw my attention to the galvanic deposits of iron shown by M. Feuquières at the Exhibition; you showed me several specimens presented to you by that inventor, as well as a plate of galvanic iron produced by M. Liet as early as 1846, and presented to the *Société d'Encouragement à Paris* by M. Welter, and, although no account of his method has been published by M. Feuquières, you were desirous of encouraging me to attempt the production of reguline deposits of this refractory metal. It is well known that the attempts made from time to time in various quarters to produce galvanic deposits of iron of a certain solidity and thickness, have failed until now; nevertheless, the above-mentioned specimen of 1846, and the recent productions of M. Feuquières, seemed to me to prove the possibility of submitting this metal to the process of electro-deposition; and, with the aid of your support and enlightened counsels, I hoped, not only to arrive at similar results, but to vanquish all those obstacles generally considered as inherent to the galvanic reduction of iron.

The scientific interest offered by this new development of electro-metallurgy, and the eminent utility of its consequent application, especially to the arts of printing and engraving, led to the commencement of my attempts in the month of October, last year, soon after my return to St. Petersburg.

The specimens which I have now the honour of submitting to your notice, consist of—1st, a tablet of iron, 150 centimetres square, and 2 millimetres thick; 2nd, of several medals; 3rd, of a medallion composed of thirty-four cameos, and 13 centimetres in diameter; 4th, of a page of moveable type stereotyped in iron, 84 centimetres square, and the block of a drawing, guillochéed with the most delicate strokes, both destined for the typographic press; several prints of different colours taken from these blocks are subjoined. These specimens will serve to show the successive progressions realised since the commencement of my experiments. You will perceive that the first plate and the first medals plated by me, present, on the reverse sides, sundry porosities and deep cavities, penetrating even, in some places, the entire thickness of the deposit; however, these cavities may also be remarked in great number in the deposits of M. Fequières. In my more recent productions these cavities, which probably proceed from bubbles of gas, have disappeared, and the reverse sides of the objects are in no way inferior to those of deposits of copper made under the most favourable conditions. In the experiments of which I now have the honour of giving you an account, my starting point was the known process of covering engraved copper plates with a coating of steel, which is quite successful in a bath composed of the chlorides of ammonium and iron, to which I added a minimum quantity of glycerin. Nevertheless, all who have attempted coating with steel must have observed, when endeavouring to give greater thickness to a very thin and brilliant layer of steel, that the surface cracks, and the deposit detaches itself from the cathode in very brittle spangles. Other baths, composed in a uniform manner, and capable of being employed under the same conditions, must therefore be used. They may be classed under two categories, comprising baths composed of sulphate of iron, and sulphate or chloride of ammonium. I first prepared three baths, according to the formula FeO,SO_3+AmO,SO_3+6HO, differing only in the manner of their preparation. The first bath consisted of a concentrated solution of crystals of the double salt, $FeO,SO_3+AmO.SO_3+6HO$, before-mentioned; the second was composed of an admixture of the concentrated solutions of each of these two salts, in the proportions of their equivalents; the third bath, which distinguished itself meritoriously from the others, was obtained by taking a solution of sulphate of iron, precipitating the iron by carbonate of ammonium, and dissolving the precipitate in sulphuric acid, thus avoiding all excess of acid. For the preparation of the baths in the second category, I either mixed solutions of chloride of ammonium and sulphate of iron in the proportions of their equivalents, or I dissolved, in a solution of sulphate of iron, at a temperature of about 15° Reaumur, as much chloride of ammonium as it would take. All these baths were as highly-concentrated and as neutral as possible.

I used, for an anode, plates of sheet iron presenting a surface nearly eight times as large as that of the copper cathode. Upon the employment for decomposition of one of Daniel's cells, there were formed upon all the cathodes in the course of 24 hours, irregular deposits full of cracks, which, on the slightest attempt to remove them, broke into a thousand pieces.

As it often happens that solutions of sulphate of copper improve by use, I was in hopes that ferruginous solutions might present some analogy in this respect; I therefore continued the experiments for some days, without, however, obtaining better results. By employing, according to your advice, instead of one cell of Daniel to each of the five decomposing troughs, four much weaker Meidinger's couples, and combining them successively with the five decomposing cells, I obtained a much slighter development of hydrogen on the cathodes, and better results. Eventually, though the appearance of the deposits still left much to be desired, especially those formed in the bath of sal ammoniac, which, from their great porosity, almost resembled sponge, those formed in the bath containing sulphate of ammonium, showed no cracks, but were formed in brilliant rays pointing upwards, and not completely covering the copper cathode. In former experiments I had observed that deposits of this nature ensued from the employment of baths accidentally containing an excess of acid; and upon examining my baths I discovered a much greater acid reaction than before. This I attributed to the fact that the quantity of iron deposited on the cathode was much greater than that dissolved from the anode. It was therefore necessary to give greater solubility to the anode, and as this result was not to be obtained by further augmentation of its surface, I conceived the idea of plunging a plate of copper into the bath, and combining it with the iron anode.

The result of this combination was most surprising; not only did the baths in the first category become re-neutralised in a few hours, but the deposits became much smoother, their colour a dull grey, and adhered perfectly to the cathode without forming bubbles, or cracking in any part. Their surfaces remained quite smooth during the first twenty-four hours, after which there began to form, in several places, the characteristic cavities, corresponding, so to speak, with those mamillary bubbles so often seen in electro deposits of copper; these cavities, however, seldom penetrated the entire thickness of the deposit. Their production is curious, and can only be attributed to an evolution of gas on the surface of the cathode, to which it is most likely that they become so firmly attached as to prevent, in some places, the formation of the deposit. It is certain, that where the energy of the current—that is, the force of the current divided by the surface of the cathode—is too great, these vexatious phenomena occur most frequently. By reducing this energy so as to render the evolution of gas imperceptible, which I managed by either diminishing the concentration of the bath, or augmenting the resistance of the solid parts of the circuit, the formation of these bubbles entirely disappeared. Of this you may convince yourself, by examining, with a magnifying glass the reverse side of the deposits recently obtained. It should be remarked that the baths of the second category give very good results when the anode employed is the combination of copper and iron.

I ought to apologise for entering into such minute details, but I think in these cases that an account of the failures is quite as useful as that of the successes; with your permission, therefore, I will add some further remarks on the electro-deposition of iron. It appears curious to me that the formation of the first layer of these deposits requires currents more or less strong, or baths more or less concentrated, according as to whether the cathode which is to receive the deposit be red or yellow copper, lead, type-metal, or black-leaded gutta percha. In all cases, the formation of a smooth deposit of iron necessitates perfect cleanliness of the surface of the cathode. Where a cathode of black-leaded gutta percha is used, the deposit forms very slowly, and the required uniformity is often wanting; it is, therefore, preferable to cover moulds of this kind with a very thin coat of galvanic copper, and, after well rinsing in water, to transfer them direct from the copper bath into the iron bath; the thin coat of copper may be easily removed by a soft brush and a little rotten-stone.

Galvanic iron, when first taken out of the bath, is as hard as cast-steel, and very brittle, but when annealed at a temperature of dull redness, it loses much of its harshness and hardness; when further annealed to red heat, it is malleable, and may be engraved as easily as soft steel. I am happy to say that when made under favourable conditions, and annealed uniformly, and with the proper precautions, electro-deposits are not subject to twist, bend, or blister. There is no contraction, but, on the contrary, an almost imperceptible dilatation; this is of importance where the complete similarity of blocks is required, as their dimensions should receive no sensible alteration on being annealed. I propose, at some future time, to determine the specific gravity of this iron before and after annealing.

It appears that galvanic iron has no permanent magnetism, but will receive magnetism like soft steel.—(*Bulletin de la Société d'Encouragement*, xv., 288.)

HARD AND UNYIELDING CEMENTS.

By M. SCHWARTZE.

To four or five parts of clay, thoroughly dried and pulverised, add two parts of fine iron filings free from oxide, one part of peroxide of manganese, one-half of sea salt, and one-half of borax. Mingle thoroughly and render as fine as possible, then reduce to a thick paste with the necessary quantity of water, mixing thoroughly well. It must be used immediately. After application it should be exposed to warmth, gradually increasing almost to white heat. This cement is very hard, and presents complete resistance alike to red heat and boiling water.

Another Cement.—To equal parts of sifted peroxide of manganese and well pulverised zinc white, add a sufficient quantity of commercial soluble glass to form a thin paste. This mixture, when used immediately, forms a cement quite equal in hardness and resistance to that obtained by the first method.—(*Blätter für Gewerbe*).

SCHOOLS OF CHEMISTRY.

EXAMINING BOARDS.

UNIVERSITY OF LONDON.

The University of London is not an educating body; it simply grants degrees. The Matriculation Examination includes the following subjects:—

Heat—its sources. Expansion. Thermometers—relations between different Scales in common use. Difference between Temperature and Quantity of Heat. Specific and Latent heat. Calorimeters. Liquefaction. Ebullition. Evaporation. Conduction. Convection. Radiation.

Chemistry of the Non-Metallic Elements, including their compounds as enumerated below—their chief physical and chemical characters—their preparation—and their characteristic tests.

Oxygen, Hydrogen, Carbon, Nitrogen, Chlorine, Bromine, Iodine, Fluorine, Sulphur, Phosphorus, Silicon.

Combining Proportions by weight and by volume. General nature of Acids, Bases, and Salts. Symbols and Nomenclature.

The Atmosphere—its constitution; effects of Animal and Vegetable life upon its composition.

Combustion. Structure and properties of Flame. Nature and composition of ordinary Fuel.

Water.—Chemical peculiarities of Natural waters, such as rain-water, river-water, spring-water, sea-water.

Carbonic Acid. Oxides and Acids of Nitrogen. Ammonia. Olefiant Gas, Marsh Gas, Sulphurous and Sulphuric Acids, Sulphuretted Hydrogen.

Hydrochloric Acid. Phosphoric Acid and Phosphuretted Hydrogen. Silica.

DEGREE OF BACHELOR OF SCIENCE (B.SC.).

This Degree is conferred on candidates who pass a satisfactory examination in Mathematics, Mechanical and Natural Philosophy, Botany, and Vegetable Physiology, Zoology, and Chemistry.

For the first examination of the Candidate, a knowledge of Inorganic Chemistry only is necessary, including the following subjects:—

Matter—simple and compound.

Elementary bodies classed. Metallic and Non-Metallic bodies.

Chemical Combination and Mechanical Mixture. Solution.

Outlines of Crystallography. Isomorphism. Dimorphism. Allotropic conditions of matter. Chemical Affinity. Laws of Combination by weight and by volume, as deduced from the history of the individual elements. Equivalent Numbers. Equivalent Volumes. Symbolical Notation, including questions on the Unitary System. Formulæ. Nomenclature.

Chemical Actions produced under the influence of Heat. Nature of Combustion. Structure and properties of Flame. Principles of Illumination. Chemical action of Light. Photography.

Oxygen. Ozone.

Hydrogen. Water.

Nitrogen. Chemical Constitution of the Atmosphere. Diffusion of Gases. The Oxides of Nitrogen; Nitric Acid. Ammonia.

Chlorine, Bromine, and Iodine. Their compounds with Oxygen and Hydrogen. Theory of Bleaching.

Fluorine and Hydrofluoric Acid.

Sulphur. Sulphurous Acid. Manufacture and Chemical applications of Sulphuric Acid. Other Oxygen compounds of Sulphur. Sulphuretted Hydrogen.

Phosphorus. Oxygen and Hydrogen compounds of Phosphorus. Theory of Acids. Monobasic, Dibasic, and Tribasic Acids.

Carbon. Carbonic Oxide and Carbonic Acid. The principal Hydrogen compounds of Carbon. Manufacture of Coal Gas.

Silicon and Boron. Their compounds with the elements previously enumerated.

Metals. Characters of metals as a Class. Metallurgical Processes. Alloys. Classification of the Metals.

Potassium. Nitre. Gunpowder. Theory of the action of Gunpowder.

Sodium. Manufacture of Carbonate of Soda.

Barium. Strontium. Calcium. Mortars. Cements. Magnesium. Aluminum. Glass. Porcelain.

Manganese. Iron. Composition and properties of Cast Iron, Wrought Iron, and Steel. Chromium.

Cobalt. Nickel. Zinc. Cadmium.

Lead. Manufacture of White Lead.

Copper. Mercury. Bismuth. Tin. Arsenic. Antimony. Silver. Gold. Platinum.

Principal compounds of the Metals with the Non-Metallic elements. Theory of Salts.

Principles of Mineral Analysis.

Principles of Electro-Chemistry.

In the Examination for Honours, the Candidate, being not more than twenty-two years of age, who shall most distinguish himself in Chemistry and Natural Philosophy, shall receive an Exhibition of Forty pounds per annum for the next two years.

SECOND B.SC. EXAMINATION.

This examination embraces Organic Chemistry, including the following subjects:—

Ultimate analysis of Organic bodies. Calculation of Empirical Formulæ. Methods of controlling Empirical Formulæ. Determination of the Equivalents of organic acids and bases; examination of products of Decomposition; determination of the Vapour-density of volatile bodies.

Law of Substitution. Compound Radicals. Homologous Series.

The Chemical history of the Cyanogen group. Cyanogen. Hydrocyanic Acid. Cyanic Acid and Urea. Fulminates. Cyanuric Acid. Sulphocyanic Acid. Chlorides of Cyanogen. Uric Acid.

Amylaceous and Saccharine substances. Fermentation. Alcohol, Wine, Beer, Bread, &c.

Homologues of Alcohol. Ethers, simple and mixed. Oxidation of Alcohol. Aldehyde and Acetic Acid and their homologues. Anhydrides, simple and mixed. Compound Ethers.

Diatomic Alcohols and their Acids. Glycol and Oxalic Acid and their homologues.

Triatomic Alcohols. Glycerine. Fatty and Oily bodies. Saponification.

Vegetable acids—the principal.

Ammonia and its derivatives. Ammonium and Ammoniacal Salts. Amides and Amines: their Classification. The chief natural Organic Bases.

Colouring Matters. Indigo and its derivatives. Principles of Dyeing.

The chief constituents of the Vegetable organism. Cellulose. Vegetable Fibrin. Albumin, Casein, Glutin, &c.

The chief constituents of the Animal organism. Animal Fibrin, Albumin, Casein, Gelatin. Blood, Milk, Bile, Urine, &c.

Decay, Putrefaction. Destructive Distillation.

The Chemical principles of the process of Nutrition and of Respiration in Plants and Animals.

The Candidate, not more than twenty-three years of age, who, in the Examination for Honours, shall most distinguish himself in Chemistry, shall receive Fifty pounds per annum for the next two years, with the title of University Scholar.

D.SC. EXAMINATION.

Candidates are not admitted to this Examination until after the expiration of two Academical years from the time of their obtaining the degree of B.Sc. Chemical Candidates can be examined either in Inorganic or Organic Chemistry. A Certificate under the seal of the University, and signed by the Chancellor, shall be delivered at the Public Presentation for Degrees to each Candidate who has passed.

EXAMINATIONS IN CONNEXION WITH THE DEPARTMENT OF SCIENCE AND ART, SOUTH KENSINGTON.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom.

This sum is administered by the Science and Art Department.

The object of the grant is to promote instruction in Science, especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The following are among the Sciences towards instruction in which aid is given:—Acoustics, Light, Heat, Magnetism and Electricity, Inorganic Chemistry, Organic Chemistry, Geology, Mineralogy, Mining, Metallurgy.

The assistance granted by the Science and Art Department is in the form of—1. Public Examinations, in which Queen's Medals and Queen's Prizes are awarded, held at all places complying with certain conditions. 2. Payments on results to teachers. 3. Scholarships and Exhibitions. 4. Building Grants. 5. Grants towards the purchase of apparatus, &c.

Examinations in all the before-mentioned Sciences are held annually about May, through the agency of the Local Committee (which must consist of not less than five well known responsible persons) in any place in the United Kingdom which complies with the requisite conditions. The Examinations are of two kinds, but held on the same evening and conducted by the same committee. *a*. The class examinations for students under instruction

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in Science Classes, whether taught by teachers qualified to earn payments on results or not. *b*. The honours examination, of a highly advanced character.

The class examination is of two grades or stages; the first stage or elementary examination, and the second stage or advanced examination.

Application for examination must be made before the end of March, stating the number of persons and the subject or subjects in which they are to be examined.

At the May class examinations the grades of success are:—in the first stage or elementary paper, first, second, and third class; and in the second stage or advanced paper, first and second class. For the third or lowest class the standard of attainment is only such as will justify the Examiner in reporting that the instruction has been sound, and that the students have benefited by it. The standard may be raised from year to year.

To all successful students are given printed lists of results showing their position. To the first class in both stages Queen's Prizes are given, consisting of Books or Instruments, chosen by the Candidates from lists furnished for that purpose.

Four medals, one gold, one silver, and two bronze, are given in each subject for competition among the *bonâ fide* students of Science Classes who either come within the category of persons on account of whom payments can be earned, or who are under seventeen years of age. The Payments on Results are made either directly to teachers or to the committee or managers of the school. Persons are qualified to earn payments who have—*a*. obtained certificates as teachers in any of the beforementioned sciences according to the rules in force previous to January, 1867; or, *b*. obtained a First or Second Class at the May examination since that date; or, *c*, who have taken honours at the May examination.

No payments are made to a teacher on account of instruction given in subjects in which he is not so qualified.

The student must have received 25 lessons at least from the teacher or teachers in each subject in which payment is claimed since the last examination, each lesson being an attendance at a meeting of the school of at least three-quarters of an hour's duration on a separate day.

There are two Scholarships provided—the Elementary School and the Science and Art Scholarships. In both cases the scholar must be from 12 to 16 years of age and must have passed in a branch of science at the May examination.

Building Grants for New Schools may be made at a rate not exceeding 2s. 6d. per square foot of internal area, up to a maximum of £500 for any one school, under certain conditions.

A grant towards the purchase of apparatus, diagrams, &c., of 50 per cent on the cost of them, is made to Science Schools and Classes in Mechanics' and similar institutions with a properly constituted committee.

Science teachers who have taught two years consecutively, and passed not less than thirty students each year, are allowed second class railway fare and £3 towards their expenses while living in London for the purpose of visiting the South Kensington Museum and other Metropolitan institutions, in order that they may acquire for the benefit of their students a knowledge of the latest progress in those educational subjects which affect the schools, on condition that they remain there five days at least.

The fifteenth Report of the Science and Art Department gives the following information:—

The system of Science and Art instruction has reached 10,230 individuals in Science, and 105,529 individuals in Art. The Students at the School of Naval Architecture numbered 44, at the School of Mines 13 regular and 102 occasional, and at the College of Chemistry 121. At the evening lectures there was a total attendance of 2,207.

At the Royal College of Science for Ireland there were 35 individual students; 4,958 persons attended the various courses of lectures which were delivered during the year in connection with the Department in Dublin; and a course of lectures at the Edinburgh Museum of Science and Art was attended by 790 persons.

The total number of persons, therefore, who have received direct instruction as students, or by means of lectures, in connection with the Science and Art Department, is about 123,500, being an increase of over 10,000, or nearly 9 per cent on 1866, when the numbers were about 113,000.

The attendance at the museums and collections under the superintendence of the Department in London, Dublin, and Edinburgh has been 1,305,374, showing a total increase of 152,374, or 13·2 per cent on the numbers of the preceding year, which were 1,153,091.

The attendance at the Educational and Art Libraries, and at the library of the Royal Dublin Society, shows a satisfactory progress. The numbers in 1867 were 32,665, or 5,392 more than in the preceding year.

The returns received of the number of visitors at various local exhibitions to which objects of art were contributed from the Art Museum show an attendance of upwards of 62,000 persons.

The expenditure of the Department during the financial year 1866-7, exclusive of the cost of the geological survey, was £152,856 18s. 1d., while in 1867-8 it was £179,950 6s. 1d., showing an increase of £27,093 8s.

UNIVERSITY COLLEGE.

Winter Term.

Chemistry.—Professor Williamson, Ph.D., F.R.S.

Daily, except Saturday, from 11 till 12 a.m.

Fee for a Half Course, £3 3s.; for the Whole Course, £6 6s.; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

The First Half of the Course to Christmas includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The following order of subjects is adopted in it:—

Heat.—Instruments for Measuring Temperature. Decompositions produced by Heat. Expansion. Tension of Vapours. Conduction. Convection. Calorimeters. Specific Heat. Latent Heat. Evolution of Heat by Chemical Action, and by Mechanical Action. Mechanical equivalent of Heat.

Light.—Photometry. Refraction and Dispersion of Light. Study of Spectrum. Heat Rays. Chemical Rays. Construction of common Optical Instruments. Double Refraction. Polarisation. Chemical Applications of phenomena of Polarisation. Combinations and Decompositions produced by Light and Actinic Rays. Photography.

Electricity and Magnetism.—Simple Magnetic Instruments. Magnetic and Diamagnetic Bodies. Electrical Machine, Electrophorus, &c. Positive and Negative Electricity. Electrometers. Conduction. Induction. Leyden-jars, &c. Discovery of Galvanism. Various forms of Battery. Study of the Chemical Action of Galvanic Batteries. Galvanometers. Heating Effects of Battery in relation to Chemical Action. Thermo-Electricity. Rheostat, &c.

Oxygen.—Theory of Combustion. Hydrogen. Nitrogen. Composition and Chief Changes of the Atmosphere. Carbon, Chlorine, Bromine, Iodine, and Fluorine. Sulphur, &c. Phosphorus. Boron. Silicon.

The chief compounds of these non-metallic elements among themselves are studied in relation to their production, properties, and decompositions. The proportions by weight and by volume in which they combine are explained and illustrated in connection with the atomic theory.

The Second Half of the Course, extending from January to March, includes the following subjects:—

Preparation and Properties of the Chief Metals, including their Characteristic Reactions and most important Salts. Detection of Metallic Poisons. Quantitative Estimation of Metals. Principles of Classification. Monatomic, Diatomic Metals, &c.

A weekly *vivâ voce* examination is held during the First Half Course and the commencement of the Second Half Course.

Organic Chemistry.

This commences in the second week in February, and occupies five Lectures weekly till about the end of March. It includes a study of the Characteristics and Metamorphoses of the chief Organic Acids, Bases, Alcohols, Ethers, Colouring Matters, &c. Methods of Ultimate and Proximate Analysis. Determination of Molecular Weights. Theory of Types; of Compound Radicals. Phenomena of Fermentation, &c.

SUMMER TERM.

Practical Chemistry.—Professor Williamson, Ph.D., F.R.S.

I. *Elementary Course.*

About Forty Lessons of one hour each, on Tuesday, Wednesday, Thursday, and Friday, from 11 to 12, commencing in the first week of May. Students are taught the construction and use of apparatus for the preparation of the most important gases, acids, &c. The characteristic tests for the presence of the common acids and bases, including the chief metallic and other poisons. Also the processes for separating these bodies from one another.

Solutions are frequently given in the class for investigation.

The first six weeks of the Course are occupied by the study of the chief non-metallic elements and their simple compounds. Metallic salts, &c., are subsequently studied.

Fee for the Course, £4 4s., including the cost of materials and apparatus.

II. *Senior Course.*

About Ten Lessons, of two hours each, on Mondays, from 10 to 12, commencing in the first week in May. The Course includes tests for fixed and volatile organic acids, nitrogenised acids, sugars, glycerine, &c., organic bases and alkaloids, constituents of blood, milk, urine, &c.

Volumetric methods of quantitative analysis of acids, alkalies, urea, prussic acid, iron, &c., are practised.

Fee for the Course, £2 2s., including cost of materials and apparatus.

III. *Summer Matriculation Course.*

Professor Williamson, F.R.S., assisted by Mr. F. S. Barff, M.A., F.C.S.

This Course includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Course consists of about Twenty Lessons in Practical Chemistry, and of an equal number of oral lessons. The practical lessons include the preparation of the common gases and acids, &c., and the study of their characteristic properties in relation to the elementary laws of combination.

The other lesssons are chiefly devoted to those parts of the subject which require fuller oral explanation than is given in the practical lessons. They include numerous exercises and questions, to which answers in writing are given by the Students. These Lessons will begin on Wednesday, April 8th, at 11 a.m.

The Class will meet on the first five week days, from 11 to 12; and some other meetings will be announced when the Class has assembled.

Fee for the Class, £4 4s., including cost of materials and apparatus.

Analytical and Practical Chemistry.
Birkbeck Laboratory.

The instruction in the laboratory is intended for beginners as well as for more advanced students. It includes practice in the construction and use of apparatus for preparing the common gases, acids, bases, salts, &c.

Study of the qualitative methods of detecting and separating mineral or organic bodies from one another. Also quantitative analysis in the wet way, organic analyses, vapour densities, &c. Instruction in gas analysis.

More advanced students are instructed in the methods of original research, especially in organic chemistry.

When accompanied or preceded by attendance on the lectures on Chemistry, the Laboratory Course qualifies Students in the application of Chemistry to the Manufacturing Arts, Metallurgy, Medicine, or Agriculture, &c. Instruction is given in the principles and processes of gas-analysis.

The Laboratory and offices are fitted up completely with the most improved apparatus and utensils for experimental research, both for beginners and advanced Students. They are open daily from 9 am. to 4 p.m., from the 3rd of October until the end of July, with a short recess at Christmas and Easter. Saturday, from 9 to 2.

Fee for the Session, 25 guineas; six months, 18 guineas; three months, 10 guineas; one month, 4 guineas; exclusive of the expense of materials. A deduction of about 40 per cent is made for Students who can attend only three fixed days per week.

EVENING CLASSES.

Elementary Chemistry—Theoretical and Practical.

Professor Williamson, F.R.S. Monday, from 7.30 to 9.30.

A Course of Twenty Lessons, of two hours each, in the Michaelmas and Lent Terms.

The elements of Chemistry are explained to the Class, and the experiments illustrating the subject are performed by the Students.

The subject will be the common non-metallic elements and the common metals, their compounds and chief properties, and the best methods of distinguishing and separating them.

All the experiments and analyses are repeated by each Student, or by not more than two Students jointly.

Fee, including the cost of materials, &c., £2 2s. per Term.

CHEMICAL LECTURES.

ROYAL SCHOOL OF MINES AND COLLEGE OF CHEMISTRY.

Chemistry.—Professor Dr. E. Frankland, F.R.S.

The instruction in Chemical Science embraces:—

1. A Course of Lectures on Experimental Chemistry with special reference to the applications of Chemistry in the Arts and Manufactures.

2. A systematic Laboratory Course for the Practice of Chemical Analysis.

Chemical Lectures.—The Course consists of Forty Lectures on Mineral Chemistry and Thirty Lectures on Organic Chemistry.

The Lectures are delivered at the Royal College of Chemistry, Oxford Street.

Chemical Laboratory.—The general Laboratory for instruction in chemical manipulation, in qualitative and quantitative analysis, and in the method of performing chemical researches, is under the direction of Dr. Frankland. The Royal College of Chemistry having become the property of the Government, its Laboratories are used for the instruction of the pupils of the Royal School of Mines.

There are three terms in the collegiate year, of three months each, commencing in the first weeks of October, January, and April respectively. The Laboratory hours are from 10 a.m. to 5 p.m., with the exception of Saturdays, when the Laboratory closes at two o'clock.

Each Laboratory Student works independently, there being no classes. All operations are superintended by the Professor and his Assistants. A table with drawers, cupboards, and shelves, is appropriated to every pupil. The Institution supplies gas, fuel, and reagents. The larger and more expensive instruments of the Laboratory, such as air-pumps, thermometers, barometers, condensers, &c., may be used by the students, who are held responsible for their safety. The students have to provide themselves only with the apparatus specified in the Laboratory regulations. More advanced students engaged in private researches have to supply themselves with such materials as are not included amongst the ordinary reagents of the Laboratory.

Metallurgy.—Professor: Dr. Percy, F.R.S.

The course of instruction in Metallurgy consists of Lectures and Laboratory practice.

The object of the Lectures is the communication of such instruction as the student may be able to apply to the greatest practical advantage, when he may be subsequently engaged in conducting any metallurgical process.

This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy. The nature of this instruction will be adapted to the special requirements of the student. It comprises:—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c.; and the examination of ores and metallurgical products.

The charge for instruction in the Metallurgical Laboratory is £15 for three months, £12 for two months, and £7 for one month.

Evening Lectures.—This year they will consist of two courses, and will be of so strictly educational a character as to meet the wants of the training masters who desire to profit by the Science Minute of the Lords of the Committee of Council on Education. The subjects and order of succession of the courses will be—Chemistry, Physics.

KING'S COLLEGE.

Professor of Chemistry—W. A. Miller, M.D. V.P.R.S.
Professor of Practical Chemistry—C. L. Bloxam.
Demonstrator—J. T. Bottomley, M.A.

Students of the first and second years are admitted to the Course of Theoretical and Applied Chemistry. The Course commences with a view of the forces which concur to the production of Chemical Phenomena, after which the laws of Chemical Attraction are discussed, and the Non-metallic Elements and their principal Compounds are described.

The metals and their principal compounds are next examined, care being taken to point out the applications of the Science to the Arts, and the processes of the different Manufactures, of Metallurgy, and of Domestic Economy, are explained and illustrated.

Examination of the Class, both *vivâ voce* and by written papers, are held at intervals during the course at the usual Lecture hour. Dr. Miller has published a work on Chemistry, which is used as a text-book by the Class.

Third Year.—Students who have completed six Terms in this department are admitted to a Course of "Practical Chemistry," consisting of twelve Demonstrations in each term; and they go through a course of Manipulation in the most important operations of Chemistry, including the first steps of Analysis.

Any Student of this department may be admitted to this Class at any period of his study, on payment of an extra fee.

Experimental and Analytical Chemistry in the Laboratory.—The object of this Class is to afford to Students who are desirous of acquiring a knowledge of analysis, or of prosecuting original research, an opportunity of doing so under the superintendence of the Professor and Demonstrator; Students may enter, upon payment of the extra fees, at any time except during the vacation, and for a period of one, three, six, or nine months, as may best suit their convenience. The Laboratory hours are from ten till four daily, except Saturday, on which day the hours are from ten till one.

In addition to the Laboratory Fee, each Student defrays the expenses of his own experiments. The amount of this expense, which is comparatively trifling, is entirely under his own control.

EVENING CLASSES.

Classes for Evening Instruction are held at King's College from October to March, and during April, May, and June.

The Classes include one for the Elements of Chemistry and one for Practical Chemistry.

The fee for the former is £1 11s. 6d.; for the latter £2 2s. The Classes meet twice a week.

LECTURES AT LONDON MEDICAL SCHOOLS.

ST. BARTHOLOMEW'S HOSPITAL & MEDICAL COLLEGE.

WINTER SESSION.

Lecturer—William Odling, M.B. Lond., F.R.S., Fellow of the Royal College of Physicians, Fullerian Professor of Chemistry at the Royal Institution. Monday, Wednesday, and Friday, at 10 a.m.

SUMMER SESSION.

Practical Chemistry—Dr. Odling, F.R.S.

CHARING-CROSS HOSPITAL AND COLLEGE.

WINTER SESSION.

Lecturer.—Mr. C. W. Heaton, F.C.S. Monday, Wednesday, and Friday, at ten. One session £5 5s.

The Laboratory is open daily.

SUMMER SESSION.

Practical Chemistry.—Mr. Heaton, F.C.S. Monday, Wednesday, and Friday. One session, £2 2s.

ST. GEORGE'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. H. M. Noad, F.R.S. Tuesday, Thursday, and Saturday, at half-past eleven. One course, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Dr. Noad, F.R.S. Daily, at ten. One course, including the use of apparatus and materials, £4 4s.

GUY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. Alfred Taylor. Tuesday, Thursday, and Saturday, at eleven. One course, £4 4s.

SUMMER SESSION.

Practical Chemistry.—Dr. Stevenson. Monday, Wednesday, and Friday, from ten to one. One course, £4 4s.

LONDON HOSPITAL.

Lecturer on Chemistry.—Dr. Letheby, M.A., &c.

ST. MARY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. Russell, F.C.S. Monday, Tuesday, Thursday, and Friday, at 10.15.

SUMMER SESSION.

Practical Chemistry.—Dr. Russell, F.C.S. Tuesday, Thursday, and Saturday, from 11.30 to 1 p.m. One session, £3 3s.

MIDDLESEX HOSPITAL.

WINTER SESSION.

Lecturers.—Mr. Taylor and Mr. Heisch. Monday, Wednesday, Friday, and Saturday, at eleven. One session, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Mr. Taylor and Mr. Heisch. Monday, Wednesday, and Friday, at eleven. One session, £3 3s.

ST. THOMAS'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. J. Bernays. Tuesday, Thursday, and Saturday, at eleven.

SUMMER SESSION.

Practical Chemistry.—Dr. A. J. Bernays. Tuesday and Thursday, ten to twelve; Friday, eleven; Saturday, ten to one.

WESTMINSTER HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at three, p.m.; Friday at 10.30 a.m. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 10.30 a.m. One course £2 2s.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, 17, BLOOMSBURY SQUARE, W.C.

School of Pharmacy. The session (1868-9) will commence on Thursday, October 1st, and extend to the end of July.

LECTURES ON CHEMISTRY AND PHARMACY, BY DR. REDWOOD.

These Lectures will be delivered on Monday, Tuesday, and Wednesday mornings, at half-past eight o'clock, commencing on Monday, 5th October.

Part 1.—Physics in relation to Chemistry and Pharmacy.
„ 2.—Chemistry of Inorganic Bodies.
„ 3.—Chemistry of Organic Bodies.

Also Lectures on Botany and Materia Medica, by Professor Bentley. The first and second parts of this course, extending over the winter months, will be delivered at 17, Bloomsbury Square on Friday and Saturday mornings, at 8.30, commencing on Friday, October 2nd. The third part of the course, on Systematic Botany, will be delivered at the Royal Botanic Gardens, Regent's Park.

Fees.—For registered apprentices and associates of the Society, for either of the above courses, £1 1s.; for either part, separately, 10s. 6d. For those not connected with the Society, £2 2s. for either of the above courses; £1 1s. for either part separately. Students have free admission to the library and museum.

Laboratory.—The suite of Laboratories for Practical Instruction in General and Pharmaceutical Chemistry will be opened on Thursday, the 1st October, under the direction of Professor Attfield. Fee for the entire session of ten months, Twenty-five Guineas. The Laboratories are open from half past nine a.m. till five p.m. Students can enter at any period during the session.

Two Scholarships (the Jacob Bell Memorial Scholarship), of Thirty Pounds a year each, are open to competition annually in July.

The Board of Examiners meet monthly, and are required by the Pharmacy Act to examine "all candidates who may present themselves for examination in their knowledge of the Latin Language, in Botany, in Materia Medica, in Pharmaceutical and General Chemistry, and to grant Certificates of Competency."

CITY OF LONDON COLLEGE, LEADENHALL STREET, E.C.

Lecturer.—Rev. B. W. Gibsone, M.A., B.Sc. Monday evenings from seven to nine p.m.

The annual Courses consist of three terms, each averaging ten experimental lectures; fee, 5s. per term. Subjects: Junior Class, Chemistry; first year, Non-metals; second year, Metals and (time permitting) Elements of Organic Chemistry. Senior class, seven to eight p.m., Practical Analysis.

ROYAL VETERINARY COLLEGE, CAMDEN TOWN.

Chemical Professor.—Mr. R. V. Tuson.
The Session commences on October 1st.

PRIVATE TEACHERS OF CHEMISTRY IN LONDON.

Mr. J. C. Braithwaite, 54, Kentish Town Road, N.W.—Chemistry and Toxicology, Monday and Thursday; Latin, Tuesday and Friday; Botany and Materia Medica, Wednesday and Saturday. All the classes commence at eight p.m. Laboratory open daily, except Saturdays.

Professor E. V. Gardner, F.E.S.—College of Experimental, Military, and Naval Sciences, 44, Berners Street, W. Laboratory and Class Rooms open daily.

Mr. Henry Matthews, F.C.S.—Laboratory, 60, Gower Street, Bedford Square. Instruction in all branches of Practical Chemistry, particularly in its application to Medicine, Agriculture, and Commerce. Laboratory open daily (except Saturday) from ten to five; on Saturday from ten to one; and from October to March on Monday and Friday evenings from six to nine o'clock.

Mr. A. Vacher, 20, Great Marlborough Street, Regent Street.

Mr. John Newlands, F.C.S.—Laboratory, 19 Great St. Helens, Bishopsgate Street. Gives practical instruction in Analysis, and prepares gentlemen for various public examinations.

Polytechnic Institution.—Course of Thirty Lessons in Inorganic Chemistry by Mr. G. F. Downar, under the superintendence of Professor Pepper. Tuesday, 8.30 to 10 p.m.

Mr. W. A. Tilden, F.C.S., 19, Compton Street, East Hunter Street, Brunswick Square, W.C.—Evening classes to prepare for the examinations of the Pharmaceutical Society.

UNIVERSITY OF OXFORD.

Professor of Chemistry.—Sir. B. C. Brodie, Bart., M.A., F.R.S.

Demonstrator.—E. Madan, M.A.

A commodious Laboratory is attached to the new museum.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other Colleges, by competitive examination in Natural Science.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. B. Liveing, M.A.

MICHAELMAS TERM.

Practical Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at one p.m. Begins October 12.

LENT TERM.

Chemistry, by the Professor, on Mondays, Wednesdays, an Fridays, at twelve. Begins January 27.

Practical Chemistry, on the same days, at one p.m. Begins January 18.

EASTER TERM.

Chemistry by the Professor, on Mondays, Wednesdays, and Fridays, at twelve. Begins April 7.

Practical Chemistry, on the same days, at one p.m. Begins April 7.

The Chemical Laboratory of the University is open daily from ten a.m. till six p.m., so that Students can work there at such times as may be convenient to them; and the Professor will attend to give instruction at the times above specified.

PROVINCIAL SCHOOLS.

BIRMINGHAM.—MIDLAND INSTITUTE.

Lecturer on Chemistry.—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday at 8 p.m.

Practical Chemistry.—Mr. C. J. Woodward, B.Sc. Saturday 3 to 6, and 6.30. to 9.30 p.m.

TRADE SCHOOL FOR BIRMINGHAM.

The Council of the Midland Institute are endeavouring to establish a Trade School in Birmingham. At a meeting held a few days since Mr. William Kendrick, the chairman, said the fact had been established that science was in future destined to occupy a much more important place in education than had hitherto been the case, and also that in both primary and advanced instruction England was lamentably behind Continental countries. These facts had alarmed many thinking men, who perceived that, whatever the natural capabilities and advantages possessed by this country in regard to the ready supply of the raw materials, we could not afford to neglect the science which taught them the best uses to make of these materials. Since the attention of Parliament had been drawn to the subject, a good deal of interest had been created by the fact that a trade school, for the purpose of giving scientific instruction, had been established in Bristol for 13 years. There they found what might serve as a model school for the whole country, for it was doing the very work which was so much desired in all the large centres of manufacturing industry. Mr. Samuelson, M.P., through Mr. Dixon, had lately made a communication to the Council of the Midland Institute, offering to guarantee £21 for two years towards the expense of establishing such a school in Birmingham. When that communication was made to the council it was felt that it would be very culpable neglect of duty if the matter were allowed to drop, and that the question should be very fully and fairly brought before the manufacturers of the town and the public at large. The Mayor, Mr. George Dixon, M.P., Mr. Arthur Ryland, and other gentlemen, spoke in favour of the project, and ultimately the following resolution was passed:—"That this meeting approves the scheme now submitted, and recommends that it be adopted by the Midland Institute, and that an appeal be made to the town for the necessary funds—namely, £250 for immediate expenses, and a subscription list of £400 per annum, and that upon these funds being provided a school shall be established."

BIRMINGHAM.—QUEEN'S COLLEGE.

Professor of Chemistry.—Alfred Hill, M.D., Borough Analyst.

Practical Chemistry.—Professor Alfred Anderson.

The Session will commence on October 1st.

BRISTOL.—BRISTOL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Mr. Thomas Coomber, F.C.S.

Monday, Tuesday, Wednesday, and Thursday, at 8.15. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Mr. T. Coomber, F.C.S.

Daily, except Saturday, at 8 a.m. One course, £3 3s.

BRISTOL SCHOOL OF CHEMISTRY.

Conducted by Frederick W. Griffin, Ph.D.

A course of Lectures on General Chemistry, commencing in October, and Laboratory instruction throughout the year.

ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.

Professor.—Mr. A. H. Church, M.A.

Assistant.—Mr. B. J. Grosjean.

The Autumn Session commenced August 10th. Three Courses of Lectures are now being delivered.

Inorganic Chemistry.—Mondays, Tuesdays, and Thursdays.

Organic Chemistry.—Tuesdays and Wednesdays.

Agricultural Chemistry.—Mondays.

Practical Chemistry classes are held as under:—

Manipulation.—Mondays and Wednesdays.

Qualitative Analysis.—Tuesdays and Thursdays.

Quantitative Analysis.—Tuesdays and Thursdays.

The Autumn Session closes about the 18th of December, after the conclusion of the Diploma and Sessional examinations. The Spring Session commences early in February.

LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.

WINTER SESSION.

Chemical Lecturer.—Mr. J. C. Brown, B.Sc., F.C.S.

Four days per week. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Mr. J. C. Brown, B.Sc., F.C.S.

Monday, Tuesday, and Friday, at 10.15. One course, £3 3s.

The Laboratory is open daily from 10 to 4.

COLLEGE OF CHEMISTRY, LIVERPOOL.

Principal.—Dr. Sheridan Muspratt, F.R.S.E., M.R.I.A., F.C.S., &c.

Assistant.—Mr. Martin Murphy, F.C.S.

The course of instruction in this college is entirely devoted to Laboratory work. The term is three months and dates from time of entrance. Fee for working six days per week, £12 12s.; five days, £11 11s.; four days, £10 10s.; three days, £9 9s.; two days, £8 8s.; and one day per week, £6 6s. Hours of attendance from 10 a.m. till 5 p.m. The students' laboratories close at 1 o'clock p.m. on Saturdays.

Medical students may enter for one hour per day per session. Fee, £3 3s. Certificates of attendance recognised by the University and Apothecaries Hall of London, and the Apothecaries Hall of Ireland.

LEEDS SCHOOL OF MEDICINE.

WINTER SESSION.

Lecturer.—Mr. J. Chapman Wilson, F.C.S.

Daily, except Saturday, at 11 a.m. One course, £4 4s.

SUMMER SESSION.

Practical Chemistry.—Mr. Wilson, F.C.S.

Tuesdays and Thursdays, 11 to 12.30. One course, £2 2s.

LEEDS MECHANICS' INSTITUTION AND LITERARY SOCIETY'S LABORATORY.

SESSION 1868-69.

Chemical Classes for instruction in Elementary, Practical, and Analytical Chemistry.

Teacher.—Mr. George Ward, F.C.S.

The usual Sessional Course of Instruction in abstract and Applied Chemistry will commence on Thursday, October 1st, at eight p.m., on which evening the teacher of the classes will introduce the general subject in a Lecture explanatory of its principles, of the mode in which these should be studied, and also of the plan which he purposes to adopt in conducting the Classes during the Session.

Fees payable in advance:—Elementary Chemistry, Thursday, per session, £1 15s., or 5s. 6d. per month. The subscription includes a selection of apparatus and material specially adapted for the course of instruction. To pupils providing their own materials, £1 1s. per session. Organic Chemistry, Friday, per session, 10s. 6d. Practical Chemistry, Tuesday, per session, £1 1s., or 3s. 6d. per month, including apparatus and material. The session extends over seven months, from October to April inclusive.

MANCHESTER ROYAL SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Mr. Daniel Stone.

The usual course for the Medical Boards.

A Laboratory is connected with the school.

OWEN'S COLLEGE, MANCHESTER.

(IN CONNECTION WITH THE UNIVERSITY OF LONDON).

Chemistry.—Professor H.E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Junior Class.—Wednesday and Saturday, from 9.15 to 10.15 a.m.

Subject: Inorganic Chemistry, comprising the laws of chemical combination, and a description of the properties and mode of preparation of the non-metallic elementary bodies, and their most important compounds.

Senior Class.—Tuesday and Thursday, from 9.15 to 10.15 a.m.

Subjects: Inorganic and Organic Chemistry, including the properties of the metals and their compounds, and the composition and relations of the best defined groups of organic bodies, and the laws regulating their formation.

Students are expected to answer the written exercises and attend the *vivâ voce* examinations given in these classes.

Text books (for both classes): Roscoe's "Elementary Chemistry, 1868," Fowne's "Manual of Chemistry, 1868." and Miller's "Elements of Chemistry."

Fee, for each class, £3 3s. For both classes, £5 5s.

A Recapitulatory Lecture, without additional Fee, will be given on Friday at 9.15 a.m., which members of both classes will be required to attend.

Extra Class.—Wednesday, from four to five p.m.

Subject: Technological Chemistry.

The Chemical Principles involved in the most important Chemical Manufactures will be chiefly considered in this course. The subject will be discussed as follows, and as far as time will permit:—

1. Production of Heat—Heat of Combustion—Combustibles—Coal.
2. Production of Light—Coal Gas—Measurement of Illuminating Power of Coal Gas—Distillation of Coal.
3. Water and Air, as regards their Sanitary and Technological Relations.
4. Processes concerned in the manufacture and application of the Alkalies.
5. Dyeing and Calico Printing.
6. Manufacture of Acids.
7. Manufacture of Glass and Porcelain.

Students attending this class must be acquainted with the principles of Chemical Science. Fee, £2 2s.

Analytical and Practical Chemistry.

LABORATORY COURSE.

Professor.—Henry E. Roscoe, B.A., Ph.D., F.R.S.

Laboratory Assistant.—Mr. C. Schorlemmer, F.C.S.

The aim of this course is to make the student practically acquainted with Chemical Science, to enable him to conduct analysis and original research, and to fit him for applying the science to the higher branches of Art, Manufactures, and Agriculture. To accomplish this, an attendance of not less than four days per week during three whole sessions is as a rule necessary. It is very advisable that each Laboratory Student should attend or should have attended the course of Lectures on Theoretical Chemistry.

The College Laboratory will be open for students daily from 10.30 a.m. until 5 p.m., except Saturdays, when it will be closed at 1.30. The Laboratory is closed from 1.15 until 2, for dinner.

The Laboratory is fitted with every convenience for the prosecution of practical chemistry, all branches of qualitative and quantitative analysis, and original research. Each student is provided with a separate working table, set of tests, fuel, water, and gas, free of expense; but he is required to find his own apparatus, a few of the more expensive reagents, and the chemicals required for his experiments. Other apparatus or instruments of a more expensive description may be obtained on loan from the Laboratory Steward, subject to regulations to be prescribed by the Professor.

Fees for the Session.—Students working six days per week, £21; ditto, four days, £17 17s.; ditto, three days, £13 13s.; ditto, two days, £9 9s.; ditto, one day, £5 5s. Students entering the Laboratory Class at or after Christmas, for not less than two days per week, will be charged two-thirds of the fees for the whole Session.

Special Fees for Shorter Periods.—For six months, six days per week, £17 17s.; five months, ditto, £15 15s.; four months, ditto, £13 13s.; three months, ditto, £10 10s.; two months, ditto, £7 7s.; one month, ditto, £4 4s.

Chemical Calculations.—Instruction in the methods of Quantitative Estimation in Chemistry, and intended to supplement the instruction in Practical Chemistry, will be given by Mr. Schorlemmer, on Mondays, from 4 to 5 p.m.

First year's laboratory students are recommended to attend and answer the written exercises and the *vivâ voce* questions given in this class. Fee, £1 1s.

The Lectures on Chemistry in Owen's College are recognised by the University of London for its Medical Degrees, by the Royal College of Surgeons, and by the Apothecaries' Hall.

NEWCASTLE SCHOOL OF MEDICINE.

(IN CONNECTION WITH THE UNIVERSITY OF DURHAM.)

Lecturer.—Mr. A. Freire Marreco. Four days a week, at a quarter to ten.

The Laboratories are open daily from ten till five. Demonstrations from half-past nine a.m.

SCHOOL OF CHEMISTRY, 1, SURREY STREET, SHEFFIELD.

Mr. A. H. Allen, F.C.S., delivers a course of Thirty Lectures on Inorganic Chemistry, in connection with the Science and Art Department.

Day and Evening Classes for Analytical Chemistry.

SHEFFIELD SCHOOL OF MEDICINE.

During the Winter Session Mr. A. H. Allen, F.C.S. will deliver a Course of Forty-five Lectures on Chemistry

SCOTLAND.

UNIVERSITY OF EDINBURGH.

The Session will commence on Monday, November 2nd, 1868.

Professor of Chemistry.—Dr. Lyon Playfair, C.B., F.R.S.

ROYAL COLLEGE OF PHYSICIANS & SURGEONS. EDINBURGH.

Professors of Practical and Analytical Chemistry.—Dr. Stevenson Macadam and Dr. A. Crum Brown.

The Laboratories open on October 1st.

EDINBURGH VETERINARY COLLEGE.

Professor of Chemistry.—Dr. A. Dalzell, M.R.C.V.S.

ANDERSONIAN UNIVERSITY, GLASGOW.

Professor of Chemistry.—Dr. Penny, F.R.S.E., F.C.S., &c.

Assistants.—Dr. Clark, Mr. Esilman, Mr. Napier.

1. Systematic Course of Lectures and Demonstrations on Chemistry. for Medical Students, Manufacturers, Civil Engineers, Agriculturists, &c. Daily, except Saturday, from 12 to 1, commencing 27th of October and terminating in April, £2 2s.

The object of this Course, which comprises upwards of 100 Lectures, is to convey to the student a thorough knowledge of the principles of Chemistry, and the applications of the science to medicine, manufactures, agriculture, &c.

Certificates of attendance on these Lectures are received by the Royal College of Physicians of London and Edinburgh; by the Royal Colleges of Surgeons of England, Ireland, and Edinburgh; by the Faculty of Physicians and Surgeons of Glasgow; by the Army, Navy, and East India Boards; and by the Apothecaries' Halls. They also qualify for Graduation in the University of London, &c.

2. Instruction in the various branches of Practical Chemistry and Analysis in the Laboratory. Daily from 10 to 4.

After the usual preparatory training, the attention of the student is specially directed to the examination and analysis of Minerals, products of commerce and manufacture, manures, &c., and, when desired, to original research.

3. The Private Laboratory for commercial and mineral analyses and assays, and for consultations and special investigations. Open daily from 10 to 5 throughout the year.

4. Evening Course of Popular Lectures on the General Principles of Chemistry, and its application to the various branches of the Useful Arts. On Fridays at 8.30, commencing 6th of November, and terminating in April.

Students attending this Course have the privilege of competing for the Prizes and Certificates offered by the Society of Arts, and the Government Department of Science and Art.

5. Evening Course of Instruction in Practical Chemistry and Analysis. On Thursday, from 7 to 9.

6. Summer Course of Practical Chemistry for Medical Students. Three months, commencing in May, £2 2s.

UNIVERSITY OF GLASGOW.

Professor of Chemistry and Practical Chemistry—Dr. Thomas Anderson, F.R.S.E.

GLASGOW MECHANICS' INSTITUTION,

Lecturer on Chemistry.—Dr. Moffatt.

The Course of Twenty-five Lectures this Session will embrace the leading points in the various departments of Chemistry. Several new features will be introduced; amongst others the ultimate Analysis of some Organic and Inorganic Compounds. The modes of Analysis as made in the Laboratory will be shown at the Lecture-table by the aid of new and improved apparatus. Under Scientific Chemistry, an outline of the most recent researches will be given. The Lectures, as formerly, will be largely illustrated by Experiments, Specimens, &c.

The Laboratory is open daily.

CARLTON PLACE SECULAR SCHOOL, GLASGOW.

Teacher.—Mr. John Mayer, F.C.S.

Classes for Chemistry and Metallurgy in connection with the London Society of Arts and the Government Department of Science and Art, on Tuesday and Friday evenings, from 8 till 10, commencing 7th of October.

There is also a Chemistry Class for Teachers on Saturday mornings from 10 till 12.

UNIVERSITY OF ABERDEEN.

Chemistry and Practical Chemistry.—Professor Brazier, F.C.S. Fee to each Course, £3 3s.

The Winter Session commences October 28th.

IRELAND.

DUBLIN.—TRINITY COLLEGE.

Professor of Chemistry.—Dr. Apjohn, F.C.S.

The Lectures will commence on Wednesday, November 2nd, at 2 o'clock, and be continued each Tuesday, Thursday, and Saturday.

ROYAL COLLEGE OF SURGEONS, DUBLIN.

Professor of Chemistry.—Dr. Barker.

The Professor receives operating pupils into the Chemical Laboratory.

QUEEN'S COLLEGE, BELFAST.

Professor of Chemistry.—Dr. Andrews.

QUEEN'S COLLEGE, CORK.

Professor of Chemistry.—Dr. Blyth.

QUEEN'S COLLEGE, GALWAY.

Professor of Chemistry.—Dr. T. H. Rowney.

A Laboratory for Practical Instruction is attached to all the Queen's Colleges. The usual Practical Course for the Medical Boards is given in the Summer.

NEW SCIENTIFIC SCHOOLS IN PARIS.

ECOLE DES MINEURS OF SAINT ETIENNE.

The course of study is entirely gratuitous, and includes the following subjects:—The working of mines; the nature of the strata and their principal mineral elements; the art of assaying and of treating minerals; the elements of mathematics; the powers of resistance; and the general nature and mode of employment of materials used in the construction and working of mines, workshops, and transport ways; book-keeping by double entry; and mechanical drawing.

Diplomas of capacity of several degrees will be granted to the pupils on the completion of their studies. The conditions of admission are laid down in a programme to be obtained at the offices of the Minister of commerce; the candidates must possess a knowledge of the French language, of arithmetic, geometry, algebra, rectilinear, trigonometry, and descriptive geometry, to the extent required for the degree of bachelor of sciences; of chemistry to the same extent, metallurgical chemistry excepted; a good knowledge of natural philosophy; and the elements of linear and free-hand drawing, and practical geometry.

The candidate must be not under 16, and not over 25 years of age.

A New School is being formed, which will consist of four sections:—1. Mathematics; 2. Natural Philosophy and Chemistry; 3. Natural History and Physiology; 4. Historical Science and Philology; to which may be added hereafter a fifth section for juridical studies.

The sites will be the Amphitheatres and the Laboratories of the Government Institutions; the Professors, those of the College of France, of the Museum, of the Sorbonne, &c.

MISCELLANEOUS.

Death of Persoz.—With regret we announce the death of Monsieur Jean Francois Persoz, Officier de la Légion d'honneur, Professeur au Conservatoire des Arts et Métiers, Directeur de la Condition des Soies et des Laines de Paris, Membre du Conseil d'Hygienè et de Salubrité publique. He died at Paris on Saturday last, September 12th. His loss will be mourned by a large circle of relatives and scientific friends.

Manufacture of Aniline Dyes.—Messrs. Nicholson, Maule, and Co., the well-known manufacturers of the aniline dyes, have relinquished business in favour of Messrs. Brooke, Simpson, and Spiller. As all these gentlemen have for many years been connected with the business, and Mr. Spiller has carried on the management of the laboratory since the introduction of aniline dyes, the high character and uniformity in strength and quality that have always characterised the dyes of the late firm will doubtless remain unimpaired under the management of the present proprietors.

THE CHEMICAL NEWS.

Vol. XVIII. No. 460.

ACTION OF SODIUM ON FORMIC ETHER.[*]

By J. ALFRED WANKLYN,
Professor of Chemistry in the London Institution.

Part I.

Löwig and Weidmann long ago made the very remarkable observation that carbonic oxide is evolved when sodium is placed in contact with formic ether.

On referring to the excellent memoir of these chemists, which is to be found in the *Journal für Praktische Chemie* (1840), Band. xx., the following particulars may be read:—

Sodium placed in formiate of ethyl evolves a gas which is given off from the whole body of the liquid, and not from the surface of the sodium alone. The gas was subjected to analysis by being exploded with excess of oxygen, the contraction and the carbonic acid which resulted from the combustion being measured. The numerical data thereby obtained were accurately those required by pure carbonic oxide.

It was likewise shown that there is produced alcohol and ethylate of soda. In reviewing their experiments, Löwig and Weidmann remarked that sodium seemed to exercise a kind of catalytic action on formic ether, and to induce a splitting up into carbonic oxide and alcohol.

$$\overset{\text{Formiate of Ethyl.}}{C_3H_6O_2} = \overset{\text{Alcohol.}}{C_2H_6O} + CO.$$

Such, then, was the state in which the research of Löwig and Weidmann left this subject.

It will be apparent on reflection that the formation of the ethylate of soda remained to be explained, and that the existence of alcohol in presence of metallic sodium, without the occurrence of decomposition into ethylate of soda and free hydrogen, was highly remarkable.

Löwig and Weidmann also observed the formation of traces of tarry matter, but this was evidently an extremely minute by-product. They also observed formiate of soda in the ultimate product, but inasmuch as ethylate of soda will react on formic ether in presence of water in the well known manner, so as to give alcohol and formiate of soda, the finding of formiate of soda, after treatment of the mass with water, is quite intelligible, and needs no further comment.

As has just been remarked, the difficulty was how the gas could be pure carbonic oxide, and yet that alcohol and metallic sodium should be in contact.

In recent times E. Greiner has investigated this reaction, and disposed of this difficulty in a very simple manner—viz., by denying the fact. According to E. Greiner (*Jahresbericht* for 1866, p. 300), in addition to the products described by Löwig and Weidmann, there is also free hydrogen, as a product of the action of sodium on formic ether.

I have also worked on this subject quite recently. The results of my investigation are in accordance with those of Löwig and Weidmann, and in contradiction of those of Greiner. The following experiment may be cited:—

Into a tube of about 15 c.c. capacity, closed at one end and provided with a perforated cork and bent delivery tube at the other end, there was put 2·3 grammes of formic ether and ·1185 gramme of sodium. The gas which resulted was collected over water, and after remaining in contact with it for some hours, was treated with a solution of subchloride of copper in hydrochloric acid. The gas was collected in fractions. The first fraction should contain the air originally present in the tube in which the experiment was made, and all the fractions would be necessarily slightly contaminated with air derived from the water over which they were collected.

1st fraction, 130 c.c., contained 111 c.c. of carbonic oxide and 19 c.c. of residual air, &c.
2nd fraction, 100 c.c., contained 95 c.c. of carbonic oxide and 5 c.c. of residual air, &c.
3rd fraction, 100 c.c., contained 97·5 c.c. of carbonic oxide, and 2·5 c.c. of residual air, &c.

The tube having been uncorked (by which means a little air entered), a little fresh formic ether was poured into it, and the gas collected as before:—

100 c.c. contained 92·5 c.c. of carbonic oxide and 7·5 c.c. of air, &c.

It will be seen that, allowing for the 15 c.c. of air originally included in the tube, and for the small quantities of air derived from the water of the pneumatic trough, the gas must been pure carbonic oxide. No hydrogen, therefore, results from the action of sodium on formic ether.

In other experiments a much larger proportion of sodium was employed, and still the gas consisted of almost pure carbonic oxide.

The next point which was made the object of experimental enquiry was the quantitative relation between the sodium consumed and the carbonic oxide generated.

From 0·1185 gramme of sodium and an excess of formic ether, 420 c.c. of gas (moist) at 770 m.m. pressure and 18° C. were obtained. This equals 391·2 c.c. (dry) at 760 m.m. pressure and 0° C.; and correcting for 15 c.c. of air, equals 376·2 c.c., or 0·472 gramme of carbonic oxide.

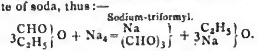
Therefore, one equivalent of sodium has liberated more than three molecules of carbonic oxide. In point of fact the action of the sodium upon formic ether belongs to the class of reactions which used to be called catalytic, a smal, quantity of sodium acting as it were by its mere presencel and effecting an indefinite quantity of decomposition of formic ether into alcohol and carbonic oxide.

I have also established, experimentally, that ethylate of soda alone is capable of resolving formic ether into carbonic oxide and alcohol. I dissolved a little sodium in alcohol of 96 per cent, and then added formic ether to the ethylate of soda, and warmed gently; a copious evolution of carbonic oxide took place.

Experiments on the action of sodium on mixtures of alcohol and formic ether, have also shown that the presence of formic ether hinders the evolution of hydrogen.

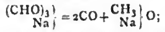
From the experimental facts which have been ascertained, it is plain that there must be two stages in the action of sodium on formic ether; the first stage in which ethylate of soda is produced, and the second stage in which ethylate of soda decomposes formic ether into carbonic oxide and alcohol.

If the action of sodium on formic ether be analogous to that on acetic ether,[*] the first stage of the reaction ought to consist in the formation of sodium-tri-formyl and ethylate of soda, thus:—



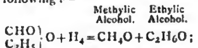
$$3\left.\begin{matrix}CHO\\C_2H_5\end{matrix}\right\}O + Na_4 = \overset{\text{Sodium-triformyl.}}{\left.\begin{matrix}Na\\(CHO)_3\end{matrix}\right\}} + 3\left.\begin{matrix}C_2H_5\\Na\end{matrix}\right\}O.$$

Probably sodium-tri-formyl splits up into methylate of soda and carbonic oxide, thus:—



$$\left.\begin{matrix}(CHO)_3\\Na\end{matrix}\right\} = 2CO + \left.\begin{matrix}CH_3\\Na\end{matrix}\right\}O;$$

And probably the action of nascent hydrogen on formic ether is the following:—



$$\left.\begin{matrix}CHO\\C_2H_5\end{matrix}\right\}O + H_4 = \overset{\text{Methylic Alcohol.}}{CH_4O} + \overset{\text{Ethylic Alcohol.}}{C_2H_6O};$$

but relative to this subject I expect to have experimental data shortly.

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[*] Original communication from the author.

[*] See Chemical News, vol. xviii., p. 122.

But, whatever be the exact history of the ethylate of soda (whether or not it be the complementary product to sodium-tri-formyl, as given in the above equation), there can be no doubt that the greater portion of the carbonic oxide evolved in the experiment above described owed its production to the action of ethylate of soda on formic ether.

Beilstein showed some years ago—and in 1864 I directed the attention of chemists to the importance of his observation—that ethylate of soda does not react upon the ethers of the fatty and aromatic acids, in the manner which it reacts on iodide of ethyl. With acetic ether, for instance, it forms a double compound, and does not yield any common ether and acetate of soda, whilst, as is well known, it forms common ether and iodide of sodium when it is treated with iodide of ethyl.

In my paper "On the Action of Sodium on Valerianate of Ethyl," published in the *Journal of the Chemical Society* for 1864, and in another paper "On the Nature of the Compound Ethers," published also about the same date, my views on this subject are developed. Acetic ether is ethylate of acetyl, and when it reacts, splits up into ethyl-oxide and acetyl. Acetic ether and ethylate of soda can only reproduce themselves by reacting on one another:—

$$\left.\begin{matrix}C_2H_3O\\C_2H_5O\end{matrix}\right\}+\left.\begin{matrix}Na\\C_2H_5O\end{matrix}\right\}=$$

$$=\left.\begin{matrix}Na\\C_2H_5O\end{matrix}\right\}+\left.\begin{matrix}C_2H_3O\\C_2H_5O\end{matrix}\right\}$$

When sodium has exchanged places with acetyl, the result is ethylate of soda and acetic ether, as at the beginning.

In a paper presented by me to the Chemical Society at the end of 1864, and suppressed by the Council, I pointed out that Ettling's strange but well known production of carbonic ether and carbonic oxide from oxalic ether and sodium, admitted of explanation, on the principles which I enunciated at that time; and having never experimented on the subject, I predicted that ethylate of soda and oxalic ether would give carbonic oxide and carbonate of ethyl. Mr. Dittmar, who was in utter ignorance of my views on this subject, has recently verified this prediction. According to recent experiments of Mr. Dittmar's, oxalic ether is resolved by ethylate of soda into carbonic ether and carbonic oxide.

The following explanation of the change occurs in my suppressed paper:—

$$2\left.\begin{matrix}Na\\C_2H_5O\end{matrix}\right\}+\left.\begin{matrix}C_2O_2\\C_2H_5O\\C_2H_5O\end{matrix}\right\}=$$

$$=\left.\begin{matrix}CO\\C_2H_5O\\C_2H_5O\end{matrix}\right\}+CO+2\left.\begin{matrix}Na\\C_2H_5O\end{matrix}\right\}$$

Sodium and oxalyl are exchangeable. Oxalyl breaks up whilst on the journey into carbonyl and carbonic oxide.

The case of ethylate of soda and formic ether is parallel with the case of ethylate of soda and oxalic ether. Formyl, on the journey, breaks up into hydrogen and carbonic oxide:—

$$\left.\begin{matrix}Na\\C_2H_5\end{matrix}\right\}O+\left.\begin{matrix}COH\\C_2H_5\end{matrix}\right\}O=$$

$$=\left.\begin{matrix}H\\C_2H_5\end{matrix}\right\}O+\left.\begin{matrix}Na\\C_2H_5\end{matrix}\right\}O+CO.$$

London Institution,
Sept. 21, 1868.

Succinic Acid from Chlorpropionic Acid.—A. Eller and H. Wichelhaus. Succinic acid as obtained from chlorpropionic acid by the action of potassic cyanide, fuses at 129·5°, dissolves in five parts of water at the ordinary temperature, and its potassic salt gives no precipitate with ferric chloride. The silver salt darkens slightly on drying.—(*Deutsch. Chem. Ges.* Berlin, 1868, 98.)

RESEARCHES ON ELECTRO-DEPOSITION.

By A. BRESTER.

THE original form of this memoir was that of an inaugural treatise submitted to the faculty of sciences of the University of Utrecht, in order to obtain the degree of doctor of physic and mathematics. A large number of organic and inorganic compounds are carefully considered by the author with regard to the phenomena presented by them on subjection to the decomposing action of a galvanic current. We refer to the original work those who wish for a detailed account of the experiments, contenting ourselves here with giving a summary of the actual results of the author's labours:—

Section 1.—1st. Hydrogen evolved by the action of zinc or iron upon dilute sulphuric acid will not reduce a solution of sulphate of silver, but will reduce a solution of nitrate of silver.

2nd. It is the same with hydrogen produced by the decomposition of steam by iron rendered incandescent; it reduces the solution of the nitrate, but not that of the sulphate of silver.

3rd. Hydrogen evolved at a platinum cathode, in the electrolysis of dilute sulphuric acid, behaves in the same manner; it reduces the solution of nitrate, and not that of sulphate of silver.

4th. Hydrogen collected at a platinum cathode, when, according to Osann's direction, an aqueous solution of recently distilled sulphuric acid is subjected to electrolysis, gives rise, it is true, in a solution of sulphate of silver, to an abundant black deposit, but that deposit consists only of sulphide of silver and not of metallic silver.

5th. Hydrogen evolved in the electrolysis of dilute sulphuric acid, a charcoal cathode being used, is also incapable of reducing a solution of sulphate of silver.

6th. Hydrogen obtained by electrolysis does not differ from ordinary hydrogen in its behaviour towards silver salts.

Section 2.—A platinum cathode which, after having served to effect the electrolysis of dilute sulphuric acid, is instantly plunged into a solution of sulphate of silver, will sometimes reduce it, but more commonly fails.

Section 3.—The combination which frequently occurs between hydrogen separated by electrolysis and the negative electrode only takes place when the electrode is of platinum.

Section 4.—1st. When nitric acid does not liberate any gas at the surface of a negative electrode of charcoal or platinum, the acid is reduced to the state of ammonia.

2nd. In the electrolysis of concentrated nitric acid the same current will not absolutely disengage any gas at a platinum or charcoal cathode; although it will separate a small quantity at a cathode of iron which has been rendered passive.

Section 5.—1st. If in the electrolysis of nitric acid, an anode of platinum wire and a cathode of silver wire be used, and after bringing them just into contact in the centre of the electrolyte, then separated, the anode assumes a dark brown colour at the place touched by the cathode.

2nd. It is frequently at this point that the gaseous evolution begins, which rapidly spreads over the whole surface of the anode, generally after the disappearance of the dark brown colour.

3rd. When once an anode has acquired the property of turning brown at the moment when the circuit is closed, it retains that property even if the cathode be withdrawn and replaced in the liquid five or six times consecutively.

4th. An anode of platinum wire, after being brought into contact with a cathode of silver wire, presents the same brown colour in concentrated sulphuric acid as in nitric acid.

5th. This brown colouring does not appear in red fuming nitric acid, in sulphates, nitrates, caustic potash, chlorhydric acid, phosphoric acid, and dilute sulphuric acid.

If the galvanic current be conducted through the medium of two platinum wire electrodes across red fuming nitric acid, no gas is at first disengaged at either electrode, and at the positive pole NO_4 is totally changed into NO_5 by oxidation. At the negative pole NO_5 is reduced to NH_3 during the whole duration of electrolysis.

Section 7.—1st. Although Davy used a battery of 200 elements to liberate the potassium contained in melted caustic potash, a battery of six elements of Bunsen is capable of producing a phenomenon of light at the surface of the cathode, also due in all probability to the combustion of the potassium.

2nd. In the electrolysis of melted caustic potash, an anode of either platinum, silver, or copper, dissolves in the fused alkali, and the above named metals are deposited on the cathode.

3rd. This electrolysis is accompanied by numerous secondary phenomena.

4th. Even without electrolysis silver will dissolve in large quantities in melted caustic potash.

Section 8.—1st. The electrolysis of melted caustic soda manifests phenomena analogous to those observed in the electrolysis of melted caustic potash.

2nd. When the electrolysis of melted alkalies occurs between a cathode of platinum wire and an anode of silver wire, a coating is formed upon the cathode, composed for the most part of silver, but which leaves, upon treatment with nitric acid, a black pulverulent residue probably of platinum.

Section 9.—In the electrolysis of sulphate of soda between two platinum electrodes, sodium is liberated at the negative pole, and combines with the platinum of the cathode.

Section 10.—1st. When melted chlorate of potash is decomposed between a platinum anode and a cathode of platinum or copper, potassium is separated at the negative pole, and unites with the platinum or copper of the cathode.

2nd.—In the same electrolysis a mixture of chlorine and oxygen takes place at the positive pole; the oxygen in this mixture has an odour of phosphorus and when brought into contact with water gives rise to thick white vapours.

Section 11.—1st. When concentrated formic acid is decomposed between two platinum plates, traversed by the current of six elements of Bunsen, a mixture of two volumes of carbonic acid and one volume of oxygen separates at the positive pole.

2nd. When concentrated formic acid is decomposed by a current of the same force, but between two electrodes of platinum wire, the mixture evolved at the positive pole consists of four volumes of carbonic acid and one volume of oxygen.

3rd. In this last electrolysis, the gaseous cation takes a volume much smaller than double that of the gaseous anion.

Section 12.—1st. Accordingly as n takes a greater value in the general formula, $C_nH_nO_4$ of fatty acids, these acids are more and more imperfect conductors of the galvanic current.

2nd. Dilute acetic acid, submitted to the action of six elements of Bunsen, evolves pure oxygen at the platinum anode.

3rd. Concentrated acetic and butyric and valerianic acid will conduct feebly the current of six elements of Bunsen.

4th. Palmitic and stearic acids in the melted state isolate perfectly the current of a battery of eight elements of Bunsen.

Section 13.—1st. Benzoic acid, $C_{14}H_6O_4$, in a fused state will not conduct the current of eight elements of Bunsen.

2nd. When an aqueous solution of benzoic acid, saturated in the cold, is decomposed between two platinum electrodes by the current of six elements of Bunsen, oxygen is separated at the positive pole and an equivalent quantity of hydrogen at the negative pole.

3rd. It is very probable that in this same electrolysis there is no separation of benzoic anhydride at the positive pole.

4th. During this electrolysis it sometimes happens that the negative electrode of platinum wire is covered with a black coating which disappears on exposure to the light.

Section 14.—1st. In the electrolysis, by five elements of Bunsen, of a saturated aqueous solution of cinnamic acid, the gaseous cation occupies a volume exactly equal to three times that of the gaseous anion.

2nd. During this electrolysis, oxygen, carbonic acid, and crystals of cinnamic acid are separated at the platinum anode.

Section 15.—1st. In the electrolysis of dilute lactic acid by the current of six elements of Bunsen, the gaseous cation takes a volume seven times larger than that of the gaseous anion.

2nd. This gaseous anion contains one volume of carbonic acid to four volumes of oxygen.

Section 16.—1st. In the electrolysis of a saturated aqueous solution of oxalic acid by a battery of six elements of Bunsen, twice as much gas is evolved at the negative pole as at the positive.

2nd. The gaseous anion resulting from this electrolysis is composed of two volumes of carbonic acid and one of oxygen.

Section 17.—1st. In the electrolysis of a saturated aqueous solution of tartaric acid by a battery of seven elements of Bunsen, hydrogen is separated at the negative and an equivalent quantity of oxygen at the positive pole.

2nd. During this electrolysis a negative electrode of sheet platinum is sometimes covered by a black coating, not apparently soluble in any acid, but which decomposes on exposure to the light.

3rd. This coating can be nothing but hydride of platinum.

Section 18.—1st. The gaseous anion liberated by electrolysis of a combination of an inorganic base with an organic acid, commonly differs greatly from the gaseous anion separated by electrolysis of the acid forming part of that combination, and employed in an isolated condition.

2nd. In electrolysing an aqueous solution of formiate of soda (density 1·197) pure carbonic acid is separated at the positive pole of a battery of six elements of Bunsen's.

3rd. During this electrolysis a light brownish red precipitate is formed upon each of the two platinum electrodes.

Section 19.—1st. In the electrolysis by the current of six elements of Bunsen of an aqueous solution of valerianate of potash, the gaseous anion is formed of—

52·91 volumes of carbonic acid.
37·37 „ „ butylene.
9·71 „ „ oxygen.

2nd. In the electrolyse of melted palmitate of soda by means of a current of five elements of Bunsen, gas is evolved at each of the platinum electrodes, and at the same time the platinum of the negative wire combines with sodium.

3rd. That which takes place in the electrolysis of melted sulphate of soda, in that of melted chlorate of potash, and in that of melted palmitate of soda, is also the same in melted sodic soap; part of the alkaline metal set at liberty at the negative pole unites with the cathode of platinum wire.

4th. Melted axunge and grease will perfectly isolate the current of a battery of ten elements of Bunsen.

Section 20.—1st. In the electrolysis by a battery of from five to eight elements of Bunsen, of a saturated neutral solution of benzoate of potash, benzoic acid and oxygen are separated at the positive, and hydrogen at the negative pole.

2nd. The volume of oxygen evolved in this electrolysis is rather less than half the bulk of hydrogen which is liberated.

3rd. After forty-eight hours' electrolysis the benzoate of potash assumes a yellowish brown colour at the positive platinum electrode.

Section 21.—1st. A saturated aqueous solution of cinnamate of soda decomposes, under the influence of the current of five elements of Bunsen, into cinnamic acid, oxygen, and hydrogen.

2nd. Part of the cinnamic acid separated in this electrolysis is transformed by the liberated oxygen into oil of bitter almonds and carbonic acid.

3rd. In the electrolysis of aqueous solutions of several acids and of the salts of these acids, it is not the anhydride of the acid which is liberated, but the acid itself.

Section 22.—1st. The gaseous anion of a concentrated aqueous solution of lactate of potash, does not nearly take half the volume of the gaseous cation; it is composed, when a current of six elements of Bunsen are used, of eighty-six volumes of carbonic acid and four volumes of oxygen.

2nd. During the electrolysis of lactate of potash, a formation occurs of aldehydic resin.

Section 23.—1st. In the electrolysis of a saturated solution of malate of potash by a current of five elements of Bunsen, the gaseous anion occupies a volume equal to ⅗ths of the volume of the gaseous cation.

2nd. 33·5 volumes of the gaseous anion are composed of thirty-two volumes of carbonic acid, and 1·5 volumes of a gas, which, on lighting, burns clearly and brilliantly.

3rd. In this electrolysis there is separated at the positive pole, in addition to malic acid, a volatile acid.

4th. The solution of malate of potash assumes, at the platinum anode during electrolysis, a light yellow colour, and at the end of eight days turns to reddish brown without new action from the current.

Section 24.—1st. *Eau sucrée* of a density of 1·13 offers to the current of a battery of four elements of Bunsen, a degree of conductibility about thirty-nine times less than that of sulphuric acid 1·24 in density.

2nd. According as the density of the *eau sucrée* increases from 1, its conducting power first augments and afterwards decreases.

3rd. In the electrolysis of *eau sucrée* between two electrodes of platinum wire, the relation between the volume of the gaseous cation and that of the gaseous anion approaches nearer and nearer to 2, according as the intensity of the current increases.

4th. The mixture of gaseous ions does not contain carbonic acid during the first moments after the commencement of the electrolysis, but after forty-eight hours it contains 6·6 p.c.

5th. *Eau sucrée* traversed by a current of six elements of Bunsen, conducted by two electrodes of platinum wire, turns acid, acquires strong reducing properties, and is precipitated by acetate of lead.

7th. By prolonging the electrolyse of *eau sucrée* the acid at first formed, is in its turn decomposed and oxidised.

8th. When the current of seven elements of Bunsen is conducted between a cathode of platinum wire and an anode of iron wire, gas is evolved at the cathode only; while at the anode a green flaky body is separated, which in the places which come in contact with the air, decomposes into a weak acid and into hydrate of iron.

9th. A copper anode also disengages no gas in the electrolysis of *eau sucrée*, but separates an unstable greenish blue substance.

10th. A zinc anode when employed in the electrolysis of *eau sucrée* becomes covered with a flaky white substance which, when washed and dried, is found to be hydrate of oxide of zinc.

Section 25.—1st. In aqueous solutions of starch, dextrine, and gum arabic, an anode of iron wire is also covered with a green and flaky salt of protoxide of iron, whose base, influenced by the oxygen in the air, abandons the acid and changes to peroxide of iron.

2nd. As long as the green substance formed in a solution of starch remains unaltered, the solution will not reduce the test liquid of the saccharine matter; but it will perform the reduction as soon as the green substance has assumed a red colour.

3rd. A solution of starch conducting the current of six elements of Bunsen between two electrodes of platinum wire, gives a neutral reaction even after five days, and does not change into sugar.

4th. Collodion conducts the current of eight elements of Bunsen very badly; but, nevertheless, yields a small quantity of gas at the cathode when the two electrodes are brought close to one another.

5th. In this electrolysis a platinum anode is covered with a gelatinous, colourless, and transparant substance, which, on being dried and burnt, burns with rapidity and deflagration in the same manner as gun cotton.

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Continued from page 82.)

Varieties of Food—their Chemical Composition and Nutritive Value.

Animal Foods.—First on the list of these is *milk*, a liquid which contains all the elements of food required by the very young, and is therefore regarded as the type or standard of food.

In some countries, as Switzerland, it is the chief diet of the peasantry; and everywhere, if easily obtained, it is largely consumed. 76 per cent of the labouring classes of England make use of it; 83 per cent take it as buttermilk, and 53 per cent as skimmed-milk. In Wales, the average consumption of it by farm labourers is 4½ pints per adult weekly—South Wales averaging only 3 pints, while in North Wales it is 7½. In Scotland the consumption among the labouring classes is still larger, for it amounts to 6½ pints per head weekly, and in Ireland it reaches 6¾ pints. Those who take least of it are the poor in-door operatives of London; the weavers of Spitalfields, for example, use only about 7·6 ozs. per head weekly, and those of Bethnal Green only a fraction above 1½ ozs. per head. When examined under the microscope, milk is found to consist of myriads of little globules of butter floating in a clear liquid. On standing for a few hours the oily particles rise to the surface and form a cream, the proportion of which is the test of quality. Cow's milk is heavier than water in the proportion of from 1,030 or 1,032 to 1,000. Asses' milk is the lightest, for its gravity is only about 1,019; then comes human milk, 1,020; and, lastly, goat and ewes' milk, which is the heaviest of all, from 1,035 to 1,042.

The quality of milk varies with the breed of the cow, the nature of its food, and the time of milking, for afternoon milk is always richer than morning, and the last drawn than the first. Taking, however, the average of a large number of samples, it may be said that cows' milk contains 14 per cent of solid matter, 4·1 of which are casein, 5·2 sugar, 3·9 butter, and 0·8 saline matter. The relations of nitrogenous to the carbonaceous is 1 to 2·2; but as fat is 2½ times more powerful than starch, the relation may be said to be as 1 to 3·6.

When milk is heated to the boiling temperature, the casein is coagulated to some extent; and if the milk has stood before it is heated, so that the cream may rise, the coagulum includes the cream, and makes the so-called Devonshire or clotted cream.

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* The Cantor Lectures, delivered before the Society of Arts.

Acids also coagulate the casein, and produce a curd, as in the making of cheese and curds and whey.

Cream is rich in butter, as will be seen by reference to table No. 3. It contains 34 per cent of solid matter, 26·7 of which are butter, and its gravity is about 1,013.

Skim-milk is the milk from which the cream has been removed. It contains only about half as much butter as new milk, and its gravity is about 1,037. In all other respects it is similar to new milk.

Buttermilk is the residue of the milk of cream from which the butter has been removed by churning. It is still poorer in fat than skim-milk, containing, in fact, only about half as much. Unless it is very fresh, it is generally a little acid, and frequently the acidity has gone so far as to set the milk into a kind of jelly.

The whey of milk is the opalescent liquor from which the curd has been removed in making cheese. Although not highly nutritious, it still holds a little casein in solution, as well as the sugar and saline matter of the milk. It is rarely used as food by the poor, but is given to pigs. In Switzerland, however, it is considered to have medicinal virtues, especially for the cure of chronic disorders of the abdominal organs, and the treatment, which is somewhat fashionable, goes by the name of *cure de petit lait*. There is a popular notion that the whey of milk is sudorific, and hence we have our wine whey, cream of tartar whey, alum whey, tamarind whey, &c., when the milk has been curdled by these several substances.

Cheese is the coagulated product of milk, obtained by the addition of rennet or a little vinegar. When cream is coagulated it makes cream cheese, which will hardly bear keeping, but must be eaten fresh. It contains about half its weight of butter, and a fifth of its weight only of curd.

When cream is added to new milk, and the mixture is curdled, it forms very rich cheese, as double Gloucester and Stilton.

When new milk alone is used the cheese is less rich, but still of high quality, as Cheddar.

When an eighth or a tenth of the cream has been taken off, it produces the quality of cheese which is most sought after, as single Gloucester, Chester, American, &c.

And when all the cream has been removed, and the skim-milk is curdled, it forms the poor cheese of Holland, Friesland, Suffolk, Somersetshire, and South Wales.

At first every variety of cheese is soft and comparatively tasteless, but by keeping they undergo change, and develope their flavours, when they are said to be ripe.

Analyses of two of the most important of them are shown on table No. 3, and it will be noticed that they contain from 56 to 64 per cent of solid matter, about half of which is curd. In skim-milk cheese the curd amounts to 44·8 per cent, and the fat to only 3·6; whereas, in Cheddar, the curd is only 28·4 per cent, and the fat 31·1. In nutritive power, therefore, especially in nitrogenous, matter, cheese ranks high, and is a valuable article of diet; but there is a limit to its digestibility, and hence it cannot be taken in large quantity. Considering its price also, it is hardly so profitable as many other foods; although where good skim-milk cheese can be purchased at from 2½d. to 3d. per pound it forms, in small quantities at a time, a good adjunct to bread.

Meat.—There is hardly a class of individuals, however poor, who do not make a strong effort to obtain meat. It would seem, therefore, to be a necessary article of diet. In this metropolis the indoor operatives eat it to the extent of 14·8 ozs. per adult weekly; 70 per cent of English farm labourers consume it, and to the extent of 16 ozs. per man weekly; 60 per cent of the Scotch; 30 of the Welsh; and 20 of the Irish. The Scotch, probably, have a larger allowance than the English, considering that braxy-mutton is the perquisite of the Scotch labourer; but the Welsh have only an average amount of 2½ ozs. per adult weekly; and the Irish allowance is still less.

It is difficult to obtain accurate returns of the quantity of meat consumed in London; but if the computation of Dr. Winter be correct, it is not less than 30¾ ozs. per head weekly, or about 4½ ozs. per day for every man, woman, and child. In Paris, according to M. Armand Husson, who has carefully collected the *octroi* returns, it is rather more than 49 ozs. per head weekly, or just 7 ozs. a day. We are not, therefore, such large meat-eaters as the French.

Butchers' meat differs very much in nutritive value according to the proportions of fat and lean; and there is a strong prejudice in favour of beef as the strongest kind of meat. In reality, however, the lean of all meat is of nearly the same nutritive power, provided it is digested; but in this respect there are large differences. The flavour also varies with the nature of the animal and with its mode of feeding. Pampas-pig, and indeed most wild swine, are horribly rank, but by proper feeding they become delicious. In store animals, the proportion of lean is always greater than the fat, and the solid matter does not amount to more than 28 or 29 per cent; not so, however, in fat animals, for then the fat is largely in excess of the lean, and the solid matters make up about half the total weight. The tendency, indeed, of the fattening process is to substitute fat for water in the carcass; and the quality of the meat depends on the intimate intermixture of fat with the muscular tissue. All animals are not alike in their method of depositing fat, for some put it upon the surface of the body, and others accumulate it among the viscera. The art of breeding and feeding stock is to overcome both of these tendencies, and, at the same time to produce a fat which will not melt or boil away in cooking. Oily foods have always a tendency to make soft fat.

The average proportions of fat and lean in the offal and carcases of animals are shown in table No. VI.

TABLE VI.—PERCENTAGE PROPORTIONS AND NUTRITIVE VALUE OF THE CARCASS AND OFFAL.

	In Animal.		Water.		Nitrogenous.		Fat.		Salts.	
	Carcass.	Offal.	Carcass.	Offal.	Carcass.	Offal.	Carcass.	Offal.	Carcass.	Offal.
Store oxen	59·3	38·9	60·8	—	18·0	—	16·0	—	5·2	—
Half fat do.	—	—	54·0	59·6	17·8	20·6	22·6	15·7	5·6	4·1
Fat do.	59·8	38·5	45·6	52·8	15·0	17·5	34·8	26·3	4·6	3·4
Fat heifers	55·6	41·3	—	—	—	—	—	—	—	—
Fat calves	63·1	33·5	62·3	64·9	16·6	17·1	16·6	14·6	4·5	3·4
Store sheep	53·4	45·6	57·3	63·7	14·5	18·0	23·8	16·1	4·4	2·2
Half fat do.	59·0	40·5	49·7	61·1	14·9	17·7	31·3	18·5	4·1	2·7
Fat do.	—	—	39·7	55·2	11·5	16·1	45·4	26·4	3·5	2·3
Very fat do.	64·1	35·8	33·0	45·1	9·1	16·8	55·1	34·5	2·8	3·6
Fat lambs	—	—	48·6	58·5	10·9	18·9	36.9	20·1	3·6	2·5
Store pigs	79·3	18·8	55·3	67·9	14·0	14·0	28·1	15·0	2·6	3·1
Fat do.	83·4	16·1	38·6	59·4	10·5	14·8	49·5	22·8	1·4	3·0
Mean of all	64·1	34·3	48·4	53·8	13·5	17·2	34·4	21·0	3·7	3·0

No. 3 (p. 79) exhibits the proportion of the principal nutritive constituents in ordinary joints of meat. Lean meat is evidently deficient of carbonaceous matter, and this is best supplied in bread or potato; but in fat meat, considering that the nutritive power of fat is twice and a half as great as that of starch or sugar, the carbonaceous matter is often in excess of the right proportion; it is remarkably so in pork, which will bear dilution with the flesh of rabbit, poultry, and veal.

The amount of bone in meat varies: it is rarely less than 8 per cent. In the neck and brisket of beef it is about 10 per cent, and in shins and legs of beef it amounts to one-third, or even half the total weight. The most economical parts are the round and thick flank, then the brisket and sticking-piece, and lastly the leg. In the case of mutton and pork, the leg is most profitable, and then the shoulder.

Horse-flesh is hardly known in this country, except as canine food; but on the Continent, and especially in Germany, Belgium, and Switzerland, it is regularly sold in the public markets, and is considered by many persons superior to beef. Possibly we have often eaten it on the Continent without knowing it. A *châteaubriand*, or double beef-steak of Paris, is said to be best of horse-flesh; and no doubt the frequenters of the *restaurants* of Paris have unwittingly acquired a fondness for it, and have relished it as good beef. A story is told by a writer in the *Saturday Review* of a Frenchman who blandly remonstrated with an Englishman for his scorn of French beef· "I have," he said, "been two times in England, but I navère find the bif supérieur to ours. I find it vary conveenient that they bring it you on little pieces of stick, for one penny, but I do not find the bif supérieur." "Good heavens!" cried the Englishman, red with astonishment, "you have been eating cat's-meat." To be serious, however, I do not see why the flesh of healthy horses should not be used as human food. It has, indeed, many powerful advocates, among whom is the great naturalist, Geoffroy St. Hilaire.

Venison and the dark flesh of other wild animals differs from butchers' meat in the circumstance that it is leaner, and that it contains more blood; but its nutritive power, when properly cooked, is not inferior to that of beef or mutton, and it is always more digestible.

The offal of meat constitutes about one-third of the entire weight of the slaughtered animal. It consists of the blood, the head and its contents, the tongue and brain, the heart and lungs, the abdominal viscera—as the diaphragm, the liver, spleen, pancreas, stomach, intestines, and reproductive organs, the feet, tail, and skin. In the case of the pig, the skin and head are parts of the carcass.

Nearly all these, when properly treated, are good for food. The blood of the pig is mixed with groats and fat, and converted into black-pudding, which contains about 11 per cent of nitrogenous matter. The stomach of the bullock is cleaned and boiled for tripe, which contains 13 per cent of albumen and 16 of fat. The heart, lungs, and pancreas, which constitute about 7 per cent of the live weight of animals, are as nutritious as lean meat. The head, especially of the ox, makes good soup; but it requires long boiling to extract the nutriment. Boiled for eight or nine hours it will yield one-fourth of its weight of gelatine; besides which an ox-cheek will furnish about 4 lbs. of good meat. Bones also contain much fat and nitrogenous matter, which they give up when broken small and boiled for many hours; 6 lbs. of bones are equal to 1 lb. of meat for nitrogen, and to nearly 2 lbs. of meat for carbon.

Bacon differs from fresh meat in the relatively large amount of fat and small proportion of water. It is an almost universal article of diet among the labouring classes. 74 per cent of farm servants use it to the extent of from ½ lb. to 2 lbs. per adult weeekly. 69 per cent of the Scotch use it, and 40 per cent of the Irish. It is preferred to butchers' meat for many reasons—as that it goes further, especially with children, who don't generally like fat; it has more relish; it is easily cooked, and suffers less waste in cooking; besides which it is easily kept, and is always handy. Preference is nearly always given to the English bacon, notwithstanding that it is double the price of American, for the flavour is better, and it does not boil away in cooking. No doubt the inferiority of American bacon is due to the method of feeding the pigs, for they run wild and eat large quantities of acorns and oily nuts. Good bacon should not lose more than from 10 to 15 per cent in cooking.

The nutritive value of both green and dried bacon are shown in tables No. 3 and No. 4. Their peculiarity is the large amount of carbonaceous matter they contain as compared with nitrogenous. Calculated as starch, it is as 20 or 24 to 1. Hence it is that it will improve the value of substances rich in nitrogen, as eggs, veal, poultry, beans, and peas.

Poultry and the white meat of rabbits are not of themselves very nourishing. They contain too much nitrogenous matter and too little fat. In the case of aquatic birds, as the goose and duck, the fat is more abundant; but it contains certain flavouring matters which are not easy of digestion. The darker flesh of game is also somewhat indigestible, and requires management in its culinary treatment.

Fish is not a favourite article of diet with the labouring classes, unless it is salted or smoked, and then it is chiefly used for its flavouring qualities. There is a prejudice that it has no nutritive strength, and it arises, perhaps, from the circumstance that it does not easily satisfy hunger, and is quickly digested; but the inhabitants of our coasts use it largely as food.

The nutritive value of the white varieties of fish, as whiting, cod, haddock, sole, plaice, flounder, and turbot, are shown in tables No. 3 and No. 4, and it will be remarked that they contain only about 22 per cent of solid matter, 18 of which is nitrogenous. They want butter, therefore, to increase their nutritive value.

Mackerel, eels, and salmon, are, however, richer in fat, for the former contains about 7 per cent and the latter 6, while the oily matter of eels amounts to nearly 14 per cent. The same is the case with the sprat, the herring, and the pilchard, and with most of our fresh-water fish.

All fish are in their best condition at the time of the ripening of the milt and roe, for not only are they fatter at that time, but when cooked they have a better flavour, and the flesh is solid and opaque. On the other hand, when they are out of condition the flesh is semi-gelatinous and watery.

Shell-fish of all descriptions have nearly the same nutritive values. They contain about thirteen parts of solid matter in the hundred, and this has the composition of white fish. Their digestibility varies—mussels, limpets, and whelks being rather hard of digestion, while scallops, cockles, periwinkles, lobsters, and crabs are, perhaps, a little more easily digested, and oysters still more so. None of them are suited for delicate stomachs, although the poorer inhabitants on the coast eat them freely; and vineyard snails on the Continent, and even slugs in China, have a reputation for delicacy and nutritive power.

Eggs contain about 26 per cent of solid matter, 14 of which is nitrogenous, and 10½ carbonaceous or fatty. The yolk is the part which contains the fat, for it there amounts to 31 per cent, while the white of the egg, which is entirely free from fat, is the richest in nitrogen —the albumen amounting to 20·4 per cent. Altogether, however, eggs are very deficient of carboneous matter, for, calculated as starch, it is only in the proportion of 1·75 to one of nitrogenous. Hence it is that eggs consort well with oil in salads, with fat bacon, and with all kinds of farinaceous matters in puddings.

Fat of some some descriptions, as butter, lard, suet, or dripping, is universally consumed. In many cases it exists in sufficient quantity in the food, as in bacon and at meat, but when this is not the case, it is invariably supplied from some other source. 99 per cent of farm labourers use fat of some sort—butter or dripping—to the extent of 5¼ ozs. weekly per adult. It is difficult to say how much is really required by the human system, but looking at the proportion in milk, it would seem to be not less than 28 per cent of the dry solid food. The fats in common use contain about 80 per cent of real fatty matter, the rest being water and salt, and although butter is the fat ordinarily purchased, yet dripping is equally valuable, and so also are the vegetable fats of the tropics. Cocoa and chocolate owe their chief value as food to the fat they contain. Cocoa is composed of 50 per cent of solid fat, called cocoa butter, and chocolate is a sweet preparation of it.

Of liquid articles of diet, beer and porter stand first in nutritive value. They contain about 9 per cent of solid matter, 8¾ of which are sugar and gum. Their nutritive value is not, therefore, great; and yet, according to Liebig, whenever beer and porter are not used, there is always a larger consumption of bread.

The nutritive functions of tea and coffee are hardly understood; for although they are largely used, and as if by an instinctive craving, yet their actual nourishing power is insignificant. I shall deal further with this subject hereafter.

The last constituent of food that we have to consider is saline matter. Broadly, it may be stated that we require phosphates and sulphates of potash, lime, and magnesia, and that we also want a still larger proportion of common salt. In most cases the phosphates and sulphates are in sufficient quantity in ordinary foods; in fact, Mr. Lawes found, in his experiments on the fatttening of animals, that for every single part of saline matter retained in the system of the pig, there were from fourteen to fifteen parts in the food; not that the whole of this was lost, for probably it performed important functions in the processes of assimilation and secretion. Common salt, however, is not present in the food to any large extent, and therefore it must be added to it.

And now, before leaving this part of the subject, let us pause to consider the vast machinery which is in operation for the supply of food to this metropolis. At the present time over three millions of people have to be fed daily; and yet so regular is the supply, that no one considers even the possibility of its failing. On the other hand, there is no redundancy; and not only does this supply regularly reach the metropolis, but it is distributed to our very doors. About 4,200 tons of fish; over 4,000 sheep; nearly 700 oxen; about 90 calves; 4,000 pigs, including bacon and hams; not less than 5,000 fowls, and other kinds of poultry; besides a million or so of oysters; and eggs innumerable, with flour enough to make nearly a million quartern loaves; and vegetables, butter, and beer in proportion, are daily brought to this city. "Imagine," as Archbishop Whately says, "a Head Commissioner entrusted wirh the office of furnishing all these things regularly to the people. How would he succeed?" And yet all this goes on with the regularity and precision of a machine, without Government or even municipal interference, but simply through the magical power and unfettered action of free-trade.

FOREIGN SCIENCE.

Paris, Sept. 16, 1868.

Researches on the Bleaching of Tissues.—Electric Pyrometer.—Academy of Sciences: Direct Transformation of Marsh Gas into more condensed Hydrocarbons.—New Reagent for the Determination of Carbonic Acid in Combination.—Colouring Matters derived from Orcine.

M. Kolb has made some researches upon the bleaching of tissues. Flax was the fibre chiefly used in the experiments. A memoir presented to the Academy comprises the first portion of the results; it developes the results furnished by studying the treatment of the fibre with alkalies, and has for its object to fix precisely the nature of the substance which passes by the names of resin, gummy matter, gum-resin, saponifiable matter, &c. Elementary analysis gave no information; it gave figures which closely approached the percentage composition of cellulose. The employment of various solvents used in organic chemistry, on the contrary, led to certain conclusions by a chain of facts. The fibre after treatment with alkalies furnished strongly-coloured lyes, which had a certain tendency to mould; this result suggested the idea of a saponification, and led to the examination, as solvents, of alcohol, ether, and essential oils. The yellow colouring matter is completely insoluble, and these liquids only remove from the fibre a white fatty matter and a green essence, the penetrating odour of which is found slightly perceptible in bleachers' lyes. The whole only constitutes 4·8 per cent of the weight of the fibre, and is the portion really saponifiable in caustic alkalies; the alkaline carbonates leave this fatty matter in the fibre, which becomes, at the same time, more supple. After exhaustion by alcohol, the fibre, boiled in weak potash, soda or ammonia solution, gave, in three cases, a loss in weight of 22 per cent. Carbonate of soda possesses exactly the same solvent power, but it acts more slowly. The brown lyes thus obtained, neutralised by hydrochloric acid, give a brown gelatinous precipitate; but the colouration of the liquid still indicates the incompleteness of the precipitation. Neither acid in excess, nor lime or baryta, will precipitate that which remains of the colouring matter in solution. This soluble portion varies according to the amount of alkali, and especially according to the duration of the ebullition; thus twelve hours' ebullition with ammonia suffices for acids to cause no precipitate in the solution. The fibre, treated by boiling water, loses at the end of a week 16 per cent of its weight, and 18 per cent when pressure intervenes; the matter dissolved is acid to litmus, colours the water slightly, and possesses the singular property of browning by simple contact with alkali. Considering these first characters, it is difficult to admit the presence of a resinous matter. Caustic alkalies or alkaline carbonates do not act as simple solvents, for in boiling the fibre with determinate amounts of carbonate of soda or sulphide of sodium, it was found that after eight hours' ebullition no trace of carbonic acid or hydrosulphuric acid remained. Resins do not give similar results; they saponify equally well with sulphides and alkaline oxides. Lime does not precipitate this substance dissolved by the alkalies; the fibre boiled with milk of lime loses the same weight as in soda, a soluble combination being formed with lime, containing 48 parts of this oxide for 100 of the colouring matter; chalk gives the same result, although more slowly. The treatment by chalk and lime presents this particular—that the solutions obtained remain colourless, and that the precipitates obtained are white. Analysis assigns to the substance soluble in alkalies and re-precipitated by acids, the following numbers:—Hydrogen, 5·0; carbon, 42·8; oxygen, 52·2.

The research has led to the establishment of the following facts:—The gummy substance which adheres to the fibres of flax is nothing else than pectose. The soaking or steeping of the fibre appears to have for its object the determination of the pectic fermentation, and the pectic acid which results remains fixed on the flax, either mechanically or in part in the form of pectate of ammonia. The caustic alkalies in the cold form gelatinous pectates, which preserve the fibre from being completely attacked. Pectic acid being weak, the alkaline carbonates have in the cold only a feeble action upon the fibre. Ebullition, on the contrary, transforms pectic acid into an energetic acid—metapectic acid, the carbonates are then strongly attacked, and their employment becomes as efficacious as that of caustic alkalies. The carbonate of soda, even in large quantity, is not a cause of the weakening of the fibre, which loses more strength from the employment of caustic soda, especially when the lye is concentrated. The employment of lime, even in the cold, weakens the fibre considerably. But the chief cause of the destruction of the solidity of the fibre is too prolonged digestion, particularly with caustic soda. M. Kolb says, that after having proved the existence of pectose in the unsteeped flax, and of pectic acid in the same flax afer steeping, it is to be hoped that the attention of chemists will be drawn to the pectic fermentation, well known, doubtless, as a scientific fact, but of which no one suspected an industrial application of so high importance.

M. Becquerel has invented an electric pyrometer for the measurement of high temperatures. Metallurgists will probably find this application very advantageous. To solve the problem of the commercial application of a thermo-electric current as a pyrometer, it was necessary to combine a thermo-electric couple by the aid of two unalterable metals, resisting the highest temperatures, and then to establish a graduated table. As to the practical installation of the pyro-electric couple, it is easily made. A table of sines has been specially constructed for these observations.

At the meeting of the Academy on the 27th of July, M. Berthelot communicated a memoir "On the Direct Transformation of Marsh Gas into more condensed Carbides;" M. Lorry, a memoir relative to "A new Reagent for the Determination of Carbonic Acid in combination in Bicarbonates and in Natural Waters;" and M. de Luynes, a memoir "On the Colouring Matters derived from Orceine."

Whenever marsh gas is formed, either by synthesis or by analysis, its formation is accompanied by that of olefiant gas, and of the condensed carbides, $C_{2n}H_{2n}$. To interpret this result, M. Berthelot had believed up to the present that a portion of the marsh gas combines, in the nascent state, with another portion of the same carbide with loss of hydrogen. Thus ethylene is first formed; this in its turn acts upon the marsh gas, giving rise to propylene, then butylene. To demonstrate this, marsh gas, carefully purified, is made to pass through a tube of porcelain heated to moderate redness; a considerable quantity of olefiant gas and of more condensed homologous carbides, such as propylene may be collected. Ethylene is the most abundant of the $C_{2n}H_{2n}$ carbides formed by the condensation of marsh gas. M. Berthelot prepared some marsh gas at a low temperature of more assured purity than that obtained from acetates. Several litres of very pure marsh gas were obtained, and the production of the $C_{2n}H_{2n}$ carbides repeated. The proportion of ethylene regenerated from its bromide (the hydrocarbons were collected as bromides, which were separated by distillation) amounted to more than 10 centimetres for every litre of marsh gas employed, notwithstanding the loss entailed in purifying the bromides.

The formation of acetylene is in relation to that of ethylene—in fact, ethylene is partially decomposed at a red heat into acetylene and hydrogen, $C_4H_4 = C_4H_2 + H_2$. Acetylene and hydrogen are produced in the nascent state, and yet these bodies in the free state reproduce ethylene. Between these three gases there is produced at redness a sort of equilibrium, which maintains so well that it is not troubled by the slower progress of molecular condensations. These notions lead to the acknowledgement of the existence of hydride of ethylene, C_4H_6, in the same media. M. Berthelot has, in fact, found that hydride of ethylene is formed by the direct reaction of ethylene and free hydrogen; reciprocally free hydride of ethylene is decomposed in part into hydrogen and ethylene. This led to the examination of whether marsh gas would engender, by its transformation, hydride of ethylene. Although the detection of a small quantity of this carbide is much more difficult than that of ethylene or acetylene, M. Berthelot thinks to have succeeded in demonstrating the existence of hydride of ethylene, in taking advantage of the much greater solubility of this carbide over marsh gas in alcohol. Several litres of alcohol were saturated with the marsh gas from the reaction; the part dissolved was disengaged by ebullition, and treated again with a quantity of alcohol insufficient to dissolve the whole; the boiling was repeated until five series of operations had been made, until the last amount of gas obtained was reduced to a few cubic centimetres. According to the analysis, the last sample of gas obtained was formed of 7·5 of hydride of ethylene, and 92·5 of marsh gas. Thus the transformation of free marsh gas furnishes hydride of ethylene—

$$C_2H_4 + C_2H_4 - H_2 = C_4H_6 = C_2H_2(C_2H_4).$$

This transformation then gives birth to the three carbides, which contain four equivalents of carbon—acetylene, ethylene, and hydride of ethylene—and these carbides are bound to each other and to hydrogen by the relations of equilibrium, so that the formation of any one of these gases necessitates the formation of the two others.

Orcine is a colourless crystalline substance which possesses, as Robignet has demonstrated, the property of becoming transformed into a violet colouring matter (orceine), under the influence of air and an aqueous solution of ammonia. This colouration is obtained in the presence of water, ammonia, and the oxygen of the atmosphere. The simultaneous presence of these three agents is necessary; without water there is no colouration. The following are some experiments M. de Luynes has made:—Into a sufficiently large thermometric tube he introduced an aqueous and boiled solution of orcine, together with ammonia and some oxidising reagents. A quantity of the liquid having entered, the tube was drawn off nearly at right angles, and the air having been expelled, the tube was sealed and afterwards heated to 50°. With bichromate of potash or ammonia, the solution assumes an intense blue tint; ammoniacal sulphate of copper is slowly, but completely, reduced. Arsenic acid is likewise reduced; arsenious acid gives no result. M. de Luynes finds orcine to yield two distinct products—a violet resinous matter, soluble in ammonia, and a crystalline matter, superficially coloured, which colours deeply by contact with acids and alkalies. The resinous matter constitutes 80 per cent of orcine, and the crystalline matter 20 per cent.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Strychnia and Ammonic Sulphydrate.—A. W. Hofmann. On mixing a cold saturated solution of strychnia in alcohol with an alcoholic solution of ammonic sulphydrate containing free sulphur, a separation of orange coloured crystals is observed which is complete after twelve hours. The mother liquor is poured off, and the crystals are washed with cold alcohol, which renders them chemically pure. They are quite insoluble in water, alcohol, ether, or carbonic disulphide. Their composition is $C_{21}H_{22}N_2O_2.H_2S_3$. When treated with strong sulphuric acid they discolour, and on addition of water oily drops of hydric peroxide are separated. No similar compounds could be obtained from quinine, cinchonine, or brucine.—(*Deutsch. Chem. Ges.*, Berlin, 1868, 81).

Camphor and Camphoric Acid.—W. Weyl. If camphoric acid is heated to 200° C. with iodhydric acid (boiling at 127°), iodine and carbonic dioxide are set free and a hydrocarbon of the composition C_9H_{18}, is formed, which after being washed with water and distilled from sodium, boils at 115—118°. From 8 grammes of camphoric acid, 4 c.c. of the purified hydrocarbon were obtained. The latter is insoluble in water, is not acted upon by bromine, but is oxidised, after a prolonged treatment with sulphuric acid and potassic dichromate, at 100° to a crystalline acid which is soluble in water, fuses, and may be volatilised without undergoing decomposition. 20 grammes of camphor treated in a similar manner with

IH produced 20 c.c. of a mixture of three hydrocarbons. By means of washing with water and repeated rectifications over sodium, the compound C_9H_{16}, boiling at 135—140°, may be separated. A greater portion boils at 163°, and has the composition $C_{10}H_{18}$. This latter when again heated with IH to 110° is converted into $C_{10}H_{20}$, with the boiling point 170—175°. C_9H_{16} and $C_{10}H_{18}$ combine with bromine without elimination of HBr. They are readily oxidised: from $C_{10}H_{18}$ four acids were obtained—acetic acid and three others, which require further examination. The author has also investigated the action of iodhydric acid on oil of turpentine, and obtained a hydrocarbon of the boiling point 163°.—(*Ibid.*, 1868, 94).

Menaphtylamine.—A. W. Hofmann. This compound is formed when an alcoholic solution of menaphtothiamide, $C_{11}H_9NS$, is treated with zinc and chlorhydric acid until the evolution of hydric sulphide has almost ceased. The base is separated by boiling off the alcohol and precipitating with sodic hydrate. It has the composition $C_{11}H_9NH_2$, and boils at 290—293° C. Its chlorhydrate crystallises in long needles; the platino-chloride,

$$2(C_{11}H_9NH_2.HCl)PtCl_4,$$

is obtained as a yellow crystalline precipitate. The base, when trated with carbonic disulphide is converted into a mass of white crystals. Alcoholic sodic hydrate and chloroform produce formomenaphtylnitrile.—(*Ibid.* 1868, 100).

Crystallised Oxichloride of Antimony and Chloride of Antimonyle.—L. Schaeffer. Oxichloride of antimony (powder of algaroth), $2SbOCl + Sb_2O_3$, is obtained in crystals of the rhombic system by heating in a sealed vessel 3 molecules of alcohol with 1 molecule of antimonious chloride to 150°C. By heating 1 molecule of alcohol with 1 molecule of antimonious chloride to 160°, the compound SbOCl, chloride of antimonyle, also in the crystalline state, is formed. The latter is insoluble in alcohol or ether; water slowly decomposes it to oxychloride and chlorhydric acid.—(*Ibid.* 1868, 135).

Azobenzid.—P. Alexeyeff. Finely divided zinc with the addition of a small quantity of potassic or sodic hydrate acts upon nitrobenzol in alcoholic solution exactly like sodium amalgam. By the same reagent azobenzid is rapidly converted into hydrazobenzid, and dichlorazoxybenzid into white needles of dichlorhydrazobenzid. Azobenzid, when heated by itself, decomposes to cyanhydric acid, aniline, benzol, diphenyle, and carbon. The author further remarks that the soluble product of reduction of nitroazoxybenzid, discovered by Zinin and examined by Schmidt, shows the same properties as, and probably is identical with, Hofmann's β-phenylenediamine.—(*Akad. z.*, St. Petersburg. 12 [1868], 480).

Chlorbenzil.—N. Zinin. Chlorbenzil, $C_{14}H_{10}OCl_2$, is readily converted into deoxybenzoin, $C_{14}H_{12}O$, by treating it with zinc and chlorhydric acid when in alcoholic, or with tin when in an acetic acid solution:—

$$C_{14}H_{10}OCl_2 + 2H_2 = C_{14}H_{12}O + 2HCl.$$

Argentic Cyanide and Sulphuric Chloride.—R. Schneider. If one part of sulphuric chloride (SCl), dissolved in ten or twelve parts of carbonic disulphide, is added to two parts of argentic cyanide, an energetic reaction takes place, during which cyanic sulphide $(CN)_2S$, is formed, together with another compound of unstable nature.—(*Akad. z.*, Berlin, 1868, 31).

Synthesis of Aromatic Acids.—V. Merz. On a former occasion the author showed that benzoic acid is produced when potassic sulphobenzolate is heated with alcalic carbonates. He now describes a method by means of which the synthesis of benzoic acid may be more advantageously effected, and which consists in heating the sulphobenzolate with potassic cyanide, and treating the benzolic cyanide thus formed with an alcoholic solution of sodic hydrate. The following is the reaction which takes place:—

$$\text{I. } C_6H_5.SO_3K + CNK = C_6H_5.CN + SO_3K_2;$$

$$\text{II. } C_6H_5.CN + 2H_2O = C_6H_5.CO_2H + NH_3.$$

In a similar manner toluilic acid may be obtained from potassic sulphotoluylate. From potassic sulphonaphtalate an acid of the composition $C_{10}H_7.CO_2H$, naphtalene-carboxylic acid, was derived,—probably identical with the compound obtained by Hofmann by the action of oxalic acid upon naphtylamine. It separates from a solution in hot water in white crystals, dissolves readily in alcohol and ether, and fuses at 140° C.—(*Zeitschr.* Ch. N.F. iv., 33).

NOTICES OF BOOKS.

Water Analysis: a Practical Treatise on the Examination of Potable Water. By J. Alfred Wanklyn, M.R.C.S., Professor of Chemistry in the London Institution, and Ernest Theophron Chapman. London: Trübner and Co. 1868.

The circumstances under which this little work appears, together with the importance of the controversy with which it is connected, render it our duty to examine it more carefully than we should otherwise have done—more carefully, indeed, than its inherent value deserves. The book is, in truth, little more than a description of the methods which the authors have proposed, and an elucidation of the results obtained by them; and these are already in the hands of every chemist. The accounts of the methods and reasonings of other chemists are for the most part meagre and imperfect, and an ill-natured reader will be apt to fancy that the book is chiefly written to enforce the simple doctrine that all that the authors have done is right, and all, or nearly all, that other people have done is wrong.

The introduction describes the method of collecting samples of a water, and indicates the necessity of observing its physical characteristics, such as colour and smell. Nothing, however, is said about the proper way of observing these important points, and the whole preliminary examination is dismissed in half a dozen lines. The authors do not even allude to the possible presence of sulphides in the water, or to their significance if found.

We may as well take this opportunity of remarking that not only is there no description of the mode of determining the dissolved gases of water, but that there is no allusion to this extremely important determination throughout the book.

Chapter I. is devoted to "Total Solid Residue." There is nothing particular to notice in it except that the authors recommend the evaporation of a smaller quantity (70 to 100 cubic centimetres) than is generally taken, that they follow Dr. Frankland in discarding the use of sodic carbonate, and that they dry the residue, after evaporation over the water-bath, at a temperature of 130° C. They also agree with Dr. Frankland in thinking the loss by burning an untrustworthy indication.

Chapter II. is on "Hardness." The details of the soap-test method are copied from Dr. Noad's "Quantitative Analysis," but we do not find any mention of the peculiar action of magnesium salts upon the soap-test, although the subject was thoroughly investigated by Campbell, and a "magnesian-hardness" table constructed many years ago. The greater part of the chapter is devoted to a consideration of the soap-test indications. A distinction is very properly drawn between the test as an indication of the soap-destroying power of the water, and as an inferential indication of the quantity of earthy salts present. The preference is given to the former mode of interpreting the result, and the soap-destroying power of pure water is therefore added on the scale to that of the calcic carbonate in the standard solution. Thus, 16 grains of chalk dissolved in 1 gallon of water is called water of 17° H., 1 gallon of water being considered equal to 1 grain of chalk, and the strength of the soap solution is changed so that thirty-four measures are required to soften it. The soap-test measures are divided into half, and they then become a tolerably correct direct measure of the soap-destroying power of the water, for the higher numbers especially. It will occur to many of our readers that there is no substantial difference between this mode of interpreting soap-test indications and that formerly used, when the standard was thirty-four measures = 16° H., and when the hardness in the higher degrees was found by the formula—

$$H = \frac{n-2}{2},$$

n representing the number of soap-test measures required. This scale and formula are still employed by some chemists, and there are certain advantages attendant upon their use. The more modern scale is, as our readers are aware, 32 measures = 16° H., and the degrees of hardness above 16° degrees are found by diluting the water before titration say to one half, halving the number of measures used, finding the hardness to which the half corresponds and doubling it. This formula is employed because the usual object has been to ascertain the chalk-equivalent present, and not the soap-destroying power of the water. It is curious to notice that some of the indications obtained by this formula are absurd—that 33 measures, for instance, only correspond to 14·95° H., while 32 measures correspond to 16° H. To apply it in determining the soap-destroying power of the water is evidently inaccurate, the object in this case being to ascertain the quantity of soap decomposed by the normal water, and not by the same water in a state of dilution.

Chapters III. and IV., on "Chlorine," and on "Nitrogen existing as Nitrates and Nitrites," need not detain us long. The modification of Schulze's aluminium process devised by Mr. Chapman (*Journal of the Chemical Society*, May, 1868), is adopted for nitrates and nitrites, and appears peculiarly suitable for the purpose. The only addition here made is an ingenious plan for determining, without distillation, the nitrogen present in these forms a plan which may often be found useful. Dr. Frankland and Mr. Armstrong's method is quoted entire, and is even treated with a certain measure of respect! But it is held to be inferior in all respects to that of Schulze. The chapter concludes with some reasoning against the notion that nitrates in potable water are always due to previous sewage contamination. The authors point to the water of chalk springs, which often contains much nitrates, and remark that the nitric acid in such cases, if it has been formed from sewage at all, can only have been formed from "fossil sewage, which was organic matter long ago in the geologic ages." Dr. Frankland's answer to this is that chalk beds form natural tanks for the reception of drainage water from the lands above, and that, therefore, the nitric acid *is* formed directly from sewage. The point must still be considered somewhat doubtful.

We now come to Chapter V., which is at once the longest and the most important in the book. It is entitled "Ammonia and Organic Matter," and is chiefly occupied by a description and development of the so-called ammonia method of examining water. Two or three pages are, indeed, devoted to other methods, but they are only slighly sketched, and are all condemned as untrustworthy. We are inclined to think that chemists have been too hasty in discarding the burning and permanganate processes. It is quite possible, even now, that with suitable modifications and greater knowledge, their indications may be found of use. Dr. Frankland and Mr. Armstrong's elaborate and most elegant method is not even described in detail. The authors dismiss it with the following curt condemnation:—"We cannot recommend this process; it is very troublesome, and, in our opinion, very inaccurate." In the appendix they reprint from the *Journal of the Chemical Society*, their objections to it. It is noteworthy that they nowhere assert that they have tried it, but this omission they would probably justify by their disbelief in the possibility of eliminating nitric acid by the use of sulphurous acid.

The history of the simple and beautiful process which the authors, in conjunction with Mr. Smith, have devised, is not a little curious, and illustrates remarkably the danger of the over-hasty publication which has on more than one occasion been adopted by the chemists of the London Institution. We have no wish to be uncharitable, and should be sorry to ascribe this habit to a mere *insanabile scribendi cacoëthes.* It is no doubt due to an excess of scientific fervour, a sort of scientific *afflatus*, which forms a part of the unconscious poetry of these gentlemen's natures, and which impels them to burst forth in pæans at the Chemical Society whenever any one of them conceives a new idea. We may admire such gushing enthusiasm, but we cannot but regret that the scientific fame which these gentlemen are acquiring, and which is destined, we trust, to be lasting, should be sullied by the publication of raw, incomplete, and sometimes inaccurate results.

On the 18th of April, 1867, Messrs. Chapman and Smith read a short paper to the Chemical Society, in which they described the very curious reaction of alkaline potassic permanganate with alcohol and lactic acid. This appears to have suggested the trial of the same reagent as an aid to water analysis. Accordingly only two months later, on the 20th of June, appeared a second paper by the same authors, in conjunction with Professor Wanklyn. In this paper the ammonia process was first announced, and the method then suggested has been but little modified since. The authors have discarded the separate distillation with potassic hydrate, and have taken to using half a litre instead of a litre. In the present work they describe a method of determining ammonia directly in the water, without distillation, which appears to present some advantages. The rest of the process is too well known to require detailed description here. The ammonia is determined directly in the water, then a portion is distilled from sodic carbonate, and the ammonia in the distillate determined, and lastly alkaline potassic permanganate is added, a second distillation made, and the ammonia once more determined in the distillate.

So far, all is well. The process is ingenious and very simple, and if the theory first put forth were correct, would leave little to desire. But, unfortunately, the authors began with a broad theoretical statement which has by no means borne the test of subsequent verification. In the original paper, it was distinctly asserted that distillation with sodic carbonate would eliminate all the nitrogen of urea in the form of ammonia, that albumenoid bodies under these circumstances lost none of their nitrogen, and furthermore, that the same albumenoid bodies would yield all their nitrogen as ammonia when distilled with alkaline permanganate. These propositions, which claimed to be based upon experiment, were very soon called in question. On the 13th of September, Mr. Dugald Campbell read a paper before the British Association, in which he pointedly denied that such sharp distinctions could be drawn. He could not get all the nitrogen from urea in the way described, and found that albumen lost much of its ammonia during the distillation with sodic carbonate. On the 7th of November, Professor Wanklyn produced a "verification" of the process, which, to the amusement of the chemical world, turned out to be in many respects a confutation rather than a verification of the original paper. His experiments with weighed quantities compelled him to admit that pure urea would not yield all its nitrogen, but only a very small part of it, when treated by the prescribed method, and furthermore, that albumen, instead of yielding the theoretical amount of ammonia during the permanganate distillation, only yielded a fraction of it, which, he said, "appears to be two-thirds of the total quantity, being at any rate a constant fraction of the total quantity." He got over the urea difficulty by asserting that, although pure urea was not decomposed under the circumstances, impure urea was; but as he added his pure urea to dilute white of egg, and also to ordinary town water, and even then failed to decompose the compound entirely, it is hard to see how he proves his point. If urea, mixed with white of egg, is pure urea, it is difficult to fancy what constitutes an impurity. In a still later paper, by Wanklyn and Chapman, a further experiment on albumen is recorded, in which 100 parts of dry albumen were found to yield "about" 10 parts of ammonia.

It is obvious that these experiments and admissions upset the lofty claims with which the process was first promulgated, and it is not surprising that Dr. Frankland, in his diligent search for absolute accuracy, should have rejected it. But it would be too much to assert that any experiments have yet demonstrated the process to be valueless. On the contrary, we are inclined to believe that from its simplicity and delicacy it is even now a very useful empirical method of judging of the quality of a water. It is, moreover, quite possible that when the conditions are better understood, a really trustworthy method, capable of giving absolute, and not merely relative, results, may be founded upon its basis. This, however, can never be achieved by the mere multiplication of analyses of waters of unknown composition, but only by a vigorous scrutiny into the mode in which the reagents act. The authors of the new method must not imagine that chemists are prejudiced against it simply because they hesitate to accept evidence so inconclusive, and of such doubtful character—evidence, moreover, which is contradicted in important points by chemists of the greatest experience. They have only to persevere in the true path of scientific logic and the precise value of their method will soon become as clear as noon-day.

We have no space to follow our authors in their criticism of Dr. Frankland and Mr. Armstrong's process. That, like the one we have been considering, awaits the verification of further experiment, and all attempts to decide on the respective merits of the two systems, except by the multiplication of researches, are sure to prove abortive. Whether the ammonia method be ultimately adopted by chemists or not, its authors are certainly entitled to the praise of having produced a very ingenious and promising process.

MISCELLANEOUS.

Schonbein.—Christian Friedrich Schönbein, whose death has been recently announced, was born at Metzingen, in Würtemberg, 18th October, 1799. When quite a young man he lived for some time in England and France. In 1828 he was appointed Professor of Chemistry in the University of Basel. His discovery of ozone took place in 1839, and that of gun cotton and collodion in 1845.

Chemical Prize to be Competed for.—Messrs. Ohlendorff and Co., of Hamburg, offer to pay the sum of £85 for the best experimental and physiological investigation of the prize subject mentioned below; and they invite the German establishments founded for investigating the applicability of artificial manure, as also agricultural chemists, and agriculturists in general, to take interest in this prize subject. The prize will be paid for that treatise which the arbitrators designate as the best of the competing treatises. The treatises must bear a motto, whilst the name of the author is adjoined in a sealed envelope; they are requested to be sent, post-paid, to Professor Dr. F. Schultze, of Rostock, not later than on the 1st of November, 1869. Besides Dr. Schultze, Professor Dr. A. Stöckhardt, of Tharand, and Dr. H. Grouven, of Salzmünde, have consented to serve as arbitrators. The decision of the arbitrators will be published before the end of the year 1869. The successful treatise will be published by Messrs. Ohlendorff. The other better treatises will also be published, if the respective authors will consent. The remaining treatises will be returned post-free. Prize subject—Uric (hippuric) acid and guanine are essential components of the guano from Peru. What is the behaviour of these components in raw guano and in prepared guano, with regard to absorption and diffusion, when acting upon different soils? Do they nourish the plants direct, or do they serve indirectly as sources of ammonia and nitric acid?—Ohlendorff and Co., Manufacturers of Prepared Guano from Peru, authorised for Germany from the Guano Depôt of the Peruvian Government, Hamburg, January 14, 1868.

British Pharmaceutical Conference.—The fifth annual meeting of the conference was held at Norwich during the meeting of the British Association, under the presidency of D. Hanbury, Esq., F.R.S. Many valuable papers were read, for some of which we hope to find space. The exhibition of objects relating to Pharmacy is yearly becoming more important. We regret that pressure on our space forbids our giving a list of the numerous objects exhibited; they were, however, all novelties of great practical interest to the Pharmaceutist. The concluding meeting was held on Tuesday, August 25, at 10 a.m. R. Fitch, Esq., Vice-President, F.S.A., F.G.S., Sheriff of Norwich, in the chair, when it was proposed by Mr. Arnold (Norwich), seconded by Mr. King (Bath), and carried *nem. con.*—"That the meeting of the British Pharmaceutical Conference for 1869 be held at Exeter, concurrently with the meeting of the British Association for the Advancement of Science." The following were balloted for and unanimously elected officers of the Conference for the year 1868-9:—*President:* D. Hanbury, F.R.S., F.L.S., &c., Plough Court, London, E.C. *Vice-Presidents who have filled the office of President:* H. Deane, F.L.S., Clapham Common, S., Prof. Bentley, F.L.S., M.R.C.S., 17, Bloomsbury Square, London, W.C. *Vice-Presidents:* W. W. Stoddart, F.G.S., Bristol, J. Ince, F.L.S., F.C.S., &c., London, G. Cooper, Exeter, H. S. Evans, F.C.S., London. *Treasurer:* H. B. Brady, F.L.S., F.C.S., Mosley Street, Newcastle-on-Tyne. *General Secretaries:* Prof. Attfield, Ph.D., F.C.S., 17, Bloomsbury Square, London, W.C., R. Reynolds, F.C.S., Commercial Street, Leeds. *Local Secretary:* Matthew Husband, 95, Fore Street, Exeter. *Committee:* J. H. Atherton, F.C.S., Nottingham, J. C. Brough, F.C.S., Kensington, A. J. Caley, Norwich, M. Carteighe, F.C.S., London, T. B. Groves, F.C.S., Weymouth, J. Palk, Exeter, R. Parkinson, Ph.D., Bradford, G. F. Schacht, Clifton, F. Sutton, F.C.S., Norwich. *Auditors:* E. Arnold, F.C.S., Norwich, G. Cubitt, Norwich. Professor Attfield, on behalf of his brother officers, fellow-members from a distance, and himself, thanked the Vice-President, Local Secretary, members of the Local Committee, and other Norwich members, for the cordiality and large-hearted hospitality with which they had been received. The meeting had been successful from all points of view; the papers had been good and numerous; the discussion on the Pharmacy Act most useful; the exhibition of pharmaceutical novelties highly interesting. For the first time, in the history of the Conference, local members had invited to their homes, for the whole week, some one or more visitors, treating them with an amount of liberality and friendliness which was scarcely precedented. There was not one of his brother members from London and other towns, but had spoken in highly laudatory terms of the successful efforts of the Norwich members,—efforts which would render pleasantly memorable this 1868 meeting.—Mr. Ince, in eulogistic terms, spoke of the time and labour which must have been expended in making the arrangements which had been so successfully carried out by the local members. The days had been so pleasantly occupied that neither he nor Mrs. Ince had had opportunity to see one-half of the objects of interest at Norwich, and similar remarks had been made by most of his friends.—Mr. Arnold and the Chairman assured the visitors that the Norwich members had derived perhaps more pleasure and profit than they had conveyed, and hoped that future meetings of the Conference would be still more agreeable and useful than the present gathering.

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2017. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the production of a red colour for dyeing and printing."—A communication from L. Durand, Bale, Switzerland.—Petition recorded June 22, 1862.

2492. F. Le Roy, Commercial Road, Middlesex, "An improved non-conducting composition for preventing the radiation or transmission of heat or cold, and an improved method of applying the same."—August 10, 1868.

2561. P. Beanes, Cordwallis, near Maidenhead, Berkshire, "Improvements in the manufacture of brewers' finings."

2562. B. Hunt, Serle Street, Lincoln's Inn, Middlesex, "Improvements in the mode of decomposing the sulphurets of iron contained in ores, coal, coke, and other mineral products, and in apparatus therefor."—A communication from E. Grandidier, and M. Rue, Paris. —August 17, 1868.

2588. F. Braby, Camberwell, Surrey, "Improvements in treating and utilising waste sulphate of iron solution, arising from the cleansing of iron surfaces, and in the manufacture of tin plates."

2589. A. Clark, Chancery Lane, "An improved compound for tanning leather."—A communication from L. H. Dennis and O. R. Brown, Stafford Springs, Tolland, Conn., U.S.A.—August 19, 1868.

2600. H. C. Ensell, St. Helens, Lancashire, "Improvements in smelting copper and other metals, and in furnaces for smelting copper and other metals, and for other purposes, and in obtaining products from the gases and vapours given off during the smelting of copper and other metals."—August 20, 1868.

2617. J. Watson, Sunderland, Durham, "Improvements in blast furnaces, and in obtaining a hot blast for the same."—August 22, 1868.

2629. O. C. Setchell, Commercial Road, Surrey, "An improved composition applicable to the manufacture of bricks, artificial stone, and various articles capable of being moulded or pressed into form."—August 24, 1868.

2647. A. E. Borgen, Seething Lane, London, "A process for the direct decomposition of neutral fatty substances for the manufacture of stearine."—A communication from J. C. A. Bock, Copenhagen, Denmark.—August 25, 1868.

NOTICES TO PROCEED.

2376.—W. R. Lake, Southampton Buildings, Chancery Lane, "An improved compound to be used as a substitute for linseed oil in the preparation of paint and varnish."—A communication from R. E. Ferguson and B. B. Ferguson, Chicago, Illinois, U.S.A.—July 29, 1868.

1283. W. Malam, Old Kent Road, Surrey, "Improvements in the manufacture of gas and in apparatus employed in such manufacture, part of the invention being also applicable to the manufacture of retorts, retort casings, crucibles, and melting pots for various useful purposes."—Petition recorded April 20, 1868.

1361. P. Spence, Newton Heath, Manchester, "Improvements applicable to the purification of gas used for illumination."—April 25, 1868.

1382. E. McDonnell, Fareham, Hampshire, "An impervious concrete or cement."

1388. A. Dietz, New York, U.S.A., "An improved method or process of treating or preparing and refining glue."—April 28, 1868.

1397. W. Wright, Mostyn, Flintshire, "Improvements in the manufacture of iron-steel."—April 29, 1868.

1424. C. D. Abel, Southampton Buildings, Chancery Lane, "The production of a new or improved colouring matter from aniline."—A communication from B. Bloch, New York, U.S.A.—May 1, 1868.

1516. J. A. Jones, Middlesborough, Yorkshire, "Improvements in the manufacture of iron and steel."—May 8, 1868.

2428. J. Scott, Sheffield, "Improvements in the preparation of food for horses, cattle, and other animals."—August 1, 1868.

NOTES AND QUERIES.

Second-hand Philosophical Apparatus.—Nindex can obtain second-hand philosophical apparatus, &c., at Mr. Stevens's Auction Rooms, King Street, Covent Garden. He must apply at the office for day of sale and catalogue.—S. P.

Testing Oak Bark, &c.—Various processes are in use for this purpose, but none can be well and fully described in the columns of "Notes and Queries," owing to becoming too lengthy for these. There are to be noted the methods of Fehling, Müller, Fraas, Hammer, H. Fleck, E. Wolft, R. Handtke, Monier and Wagner, all of which are fully described in volume five of Wagner's Hand und Lehrbuch der Technologie, published by Otto Wigand, at Leipzig.

Separation of Alumina and Sesquioxide of Iron.—Neutralise the very dilute solution of these two bases with carbonate of soda, then add hyposulphite of soda, and, finally, heat till no more sulphurous acid is disengaged. In this manner all the alumina collects together into a precipitate, which should be calcined. The iron remains in the liquor, which should be concentrated and then decomposed with chlorate of potash and hydrochloric acid. After a filtration to remove sulphur, precipitate the sesquioxide of iron by ammonia.—F. Wöhler.

Steatite is a mineral of the magnesian family; it has a greyish-white or greenish-white colour, a dull or fatty lustre, a coarse splintery fracture with translucent edges, is soft, easily cut with a knife, but somewhat tough, does not adhere to the tongue, feels very greasy, and is infusible before the blowpipe. Specific gravity from 2·6 to 2·8. It is used in the manufacture of porcelain; it is also employed for polishing serpentine, marble, and glass; is sold under the name of French chalk when in powdered state; it is also used for making gas burners. Chemical composition: silica, 62·14, magnesia, 32·92, water, 4·94. It is also used to remove stains of grease and oil from silk and woollen materials, and enters into the composition of certain crayons.—B.

Chemical Cement.—Jeffery's marine glue will answer the purpose in this case, or, perhaps better yet, a caoutchouc cement obtainable by melting carefully india-rubber, taking care to stir well during the melting process, at the same time dry fire clay is added, from 6 to 8 per cent of the weight of caoutchouc, while at last, in order to give proper consistency, slaked lime is incorporated with the mass. This cement stands the action of boiling sulphuric acid. It may perhaps not be out of place to mention here the zeiodelit, made up of nineteen parts of sulphur and forty-two parts of powdered glass or porcelain; the sulphur is molten, and the powder alluded to at the same time, heated to rather above the melting point of sulphur, and is then added to the latter, while the mixture is continually stirred; it is then cast in blocks and used, of course after heating again, for various purposes as cement, &c.—Dr. A. A.

Gallipoli Oil.—Your correspondent "S. P." must be labouring under a mistake to suppose that Gallipoli (originally), or magma oil, as it is generally termed, recovered from shoddy or woollen waste by heat and pressure (after which it is clarified by boiling in a little SO_3), can again be refined by simple exposure to light and air. This process, I believe, is successful in its original state, but not after being used by woollen manufacturers in the production of cloth; no amount of exposure or filtration through charcoal can effect the object in view, without first precipitating the colours by some chemical means, as the colours with which it is impregnated are not removable by most of the chemical means generally adopted for refining other oils. Hence the necessity of distilling this so-called magma oil, for the purpose of bringing it to its original colour. I shall feel obliged to any of your learned correspondents who can give me the necessary information.—Aberkenfig.

Peaty Soil.—"A Novice in Agricultural Chemistry" speaks of the small crops obtained from some recently-drained peat land, and is surprised at the result, as the soil must necessarily have been very rich in humus. He asks—What exhaustion has produced this sterility? In the first place, the fertility of soils is by no means associated with the presence of humus. Soils may be exceedingly fertile which contain a mere trace of carbonaceous matter, while others rich in such materials produce scanty crops. In the next place, sterility is not always to be attributed to an absolute lack of the elements of plant food, but rather to the fact that they exist in a condition unsuitable for assimilation. With regard to the case mentioned, the soil, being mainly composed of peat, will certainly be very rich in nitrogen, and will probably be tolerably well provided with the other essentials of plant food. If the land has been well drained, much has been done to render these food constituents available for the production of crops; a good dressing of lime will also aid effectually towards the same end, and is probably, under the present circumstances, the best manure that can be applied to the land.—R. W.

TO CORRESPONDENTS.

⁂ It is our pleasing duty to accord our best thanks to those gentlemen who have so kindly acceded to our request in sending us the necessary information respecting the Chemical and Medical Schools for our Students' Number.

Several correspondents have enquired where they can obtain the lamp referred to in our article "On the Measurement of the Luminous Intensity of Light." We have pleasure in informing them that Messrs. Johnson and Matthey, Metallurgists, of Hatton Garden, are making them, and will shortly have them ready.

T. D. Reed (Montreal).—Our publisher informs us that Le Technologiste for June, 1867, cannot be obtained separately.

T. B.—The pamphlet is out of print. An introduction to Chemical Philosophy, by Adolphe Wurtz, F.R.S., will give you the information you require. It can be obtained at our office, price 3s. 6d.

Communications have been received from W. F. Barrett; Dr. Penny; P. Holland; L. Oertling; Rev. B. W. Gibsone, M.A. (with enclosures); The Jarrow Chemical Co. (with enclosure); C. S. Romain; E. Rowden; W. Schofield; R. J. Williams (with enclosure); G. W. Robinson; F. S. Sillitoe; Dr. Apjohn; E. Bremridge; Brooke, Simpson, and Spiller; A. T. Brook (Michigan); W. Webb; Professor F. H. Storer, Boston, U.S.; S. M. Buck; Lawson Lint; J. W. Slater; B. H. Rogers, Victoria, Australia; O. Richter; Professor Heaton; W. M. Bowron; C. Lowe (with enclosure); Professor Liveing; J. Mayer; Dr. Moffatt; Dr. Sheridan Muspratt; J. A. Wanklyn; Messrs. Johnson and Matthey; J. Wallace Young (with enclosure); D. Forbes, F.R.S. (with enclosure); B. H. Rogers; C. M. Tidy; S. A. Sadler; W. Little (with enclosure); T. J. Shoster; E. B. Cow; Hill and Cox (with enclosure); and Dr. A. Adriani.

THE CHEMICAL NEWS.

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GLASS AND PLATINUM FORCEPS FOR MANIPULATING IN ACID AND OTHER SOLUTIONS.

By **DAVID FORBES, F.R.S. &c.**

In the last number of the *Zeitschrift für Analytische Chemie*, 1868, vol. vii, p. 224, a description is given of a pair of tongs with glass extremities, invented by Dr. Muck, and intended for manipulating in acid solutions.

The construction of this piece of apparatus seems excellent, especially when a somewhat large and strong instrument is demanded; for more delicate purposes, however, as in analytical operations, the forceps now about to be described was devised a considerable time back, and has been found extremely useful in my laboratory.

The accompanying woodcut, Fig. 1, shows these latter in front and side view, and will require but little explanation. They were made as follows:—An ordinary pair of strong surgical forceps were taken and the points cut off; a small piece of sheet brass, bent into a cylinder, was then soldered to each arm as shown at *a*; these cylinders being formed by merely bending the brass round so as to leave an open slit about one-twentieth of an inch wide in front. Two glass rods, such as are used for stirrers, as long as the glass arms of the forceps were intended to be, and just as thick as would enter these brass cylinders when pressed with some force, were rounded by the blowpipe at the one end, whilst the other, when softened, were somewhat flattened between the glassblowers' pliers, as seen in the woodcut. In order to complete the forceps it was now only necessary to push each of these rods into its corresponding brass cylinder or socket, the longitudinal slits of which, by imparting a certain amount of elasticity to the sockets, cause them to grasp the glass rods firmly, and retain them without any cement or other fixing. The relative lengths of the arms are easily adjusted by slipping one rod more or less forward, whilst the points can be made to hold and meet accurately by rubbing them down on a piece of sandstone.

Fig. 1.

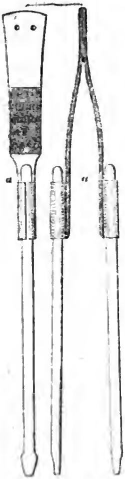
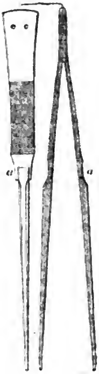


Fig. 2.



Such forceps may, of course, be made to any convenient size; the one figured in woodcut is drawn to exactly half size, and was found to be of very useful dimensions for general analytical work, especially when manipulating in nitrohydrochloric acid, nitrate of silver, and other solutions which would have acted upon metals, horn, ivory, &c.

Fig. 2 represents another convenient form of forceps, also drawn to one half the real size, with long platinum points soldered to the steel body at *a*; these have been also found of great service in general laboratory operations; especially when hydrofluoric acid is in question. They were made by Oertling, and the construction is so evident from the annexed woodcut as to require no further description.

RECENT ANALYSIS
OF THE
WATER OF THE "OLD SULPHUR WELL"
(ROYAL PUMP ROOM)
AT HARROGATE.

By **Dr. SHERIDAN MUSPRATT, M.D.(Hon.), Ph.D., F.R.S.E., &c.**
Founder and Principal of the College of Chemistry, Liverpool.

Finding singular changes in composition were going on in the springs at this fashionable watering place, I have from time to time during the last seven years analysed its several spas. It is now acknowledged that Harrogate stands at the head of British watering places, both on account of the variety and efficacy of its mineral springs, the beauty of its locality, and the salubrity of its air. Dr. Myrtle in his admirable work recently published, "Practical Observations on Harrogate Waters," remarks, "Patients return regularly, year after year, for twenty, thirty—aye, forty years; I know cases that never miss their three or four weeks of Harrogate water;" and the late Dr. Kennion wrote:—"Since the discovery of the chloride of iron water or 'Dr. Muspratt's chalybeate,' the place is more resorted to than ever, for this remarkable spring is without a prototype."

Annexed is the tabulated composition deduced from the new results:—

	Grains in the Imperial Gallon.
Carbonate of lime	10·545
Carbonate of magnesia	2·864
Chloride of sodium	862·412
Chloride of potassium	69·897
Chloride of magnesium	61·769
Chloride of calcium	79·878
Chloride of barium	4·998
Chloride of strontium	mere traces
Chloride of lithium	
Sulphide of sodium	16·418
Iodides, bromides, ammonia, &c.	mere traces
	1108·781

Cubic inches of carbonic acid in the gallon 25·55
Cubic inches of sulphide of hydrogen ,, 7·01

This water, which emanates from a peat bog, is perfectly transparent as it issues to the light, and smells strongly of sulphide of hydrogen with which it is impregnated, and is naturally most saline to the taste, owing to the very large quantity of chloride of sodium which it holds in solution. Since my friend Dr. Hofmann's analysis in 1854, the water has parted with its very small amount of sulphate of lime, and acquired considerable quantities of carbonate of magnesia, chloride of barium, &c. Several of its active constituents (sulphide of sodium, chlorides of potassium, magnesium), are augmented. Its total solid contents are increased *twelve grains* in the gallon. As regards its stimulating, aperient, resolvent, alterative, and other effects, they are so well known, especially in hepatic diseases, as to need no further recommendation or observation.

College of Chemistry, Liverpool,
September 1868.

ON SUSSEXITE,

A NEW BORATE FROM MINE HILL, FRANKLIN FURNACE, SUSSEX COUNTY, NEW JERSEY.

By GEORGE J. BRUSH.

In examining a specimen of a fibrous mineral, obtained at Mine Hill last year, I found that it was a fibrous silicate of zinc, and being desirous of further investigating the mineral, I requested my assistant, Mr. Wm. G. Mixter, on his recent visit to the locality, to obtain as much of the fibrous substance as possible, so that a quantitative analysis might be made of it. Mr. Mixter was fortunate in obtaining one specimen of what we at first sight took to be the fibrous silicate, but on examination of its pyrognostic characters it proved to be a new mineral, a hydrous fusible borate, reacting strongly with the fluxes for manganese. This interesting discovery led me at once to revisit the locality, and I there succeeded in obtaining enough of the new mineral to give the following characters. It is found in the franklinite vein at the opening on the north end of Mine Hill, associated with franklinite, zincite, willemite, tephroite, calcite, and what appears to be a double carbonate of manganese and magnesia occurring, implanted on, or imbedded in the fibrous mineral in minute hemispherical forms; it has also associated with it a black hydrate of manganese, apparently the species manganite, and a pale pink carbonate, which is probably rhodochrosite. The black manganite and the double carbonate have the appearance of being products of the alteration of the borate, since where associated with these the latter seems exceedingly friable and evidently in process of decomposition.

The pure mineral is whitish with a tinge of yellow or pink, is translucent on the edges and in thin fragments, and possesses a silky to pearly lustre. The structure is fibrous, sometimes asbestiform, although in other specimens it seems to cleave much more readily in one direction than in a direction at right angles to this, yielding flat fibrous fragments. The mineral occurs in seams in calcite, sometimes with the fibres running transversely, and in other specimens quite long and parallel to the seam. The hardness is slightly above 3, scratching calcite, but not arragonite. Specific gravity = 3·42.

On heating in the closed tube the mineral darkens slightly in colour, and yields water which reacts neutral to test-papers; but if turmeric paper is moistened with this water, then with a drop of dilute chlorhydric acid, and afterwards dried, it assumes the red colour, characteristic of boric acid, and thus shows that at least a trace of this acid is driven off with the water. In the forceps the mineral fuses in the flame of a candle (F. = 2), and B.B. in O.F. yields a black crystalline mass and colours the flame intensely yellowish-green. With borax and salt of phosphorus gives a deep amethystine bead in O.F., which in R.F. becomes colourless and transparent. With soda yields a green manganate.

It is readily dissolved in chlorhydric acid, and most specimens thus treated give off a minute quantity of chlorine, showing traces of a slight alteration of the protoxide of manganese into a higher oxide. On evaporation to dryness and resolution in acid, minute imponderable traces of silica were found. Qualitative analysis proved the presence of boric acid, manganese, magnesia, and water, with questionable traces of zinc and soda. A fragment of the mineral moistened with sulphuric acid and held in the flame of an ordinary Bunsen burner, gave, when observed through the spectroscope, the characteristic spectrum of boric acid.

The exceedingly simple composition of the mineral rendered the quantitative determination of the bases comparatively easy. The mineral being dissolved in chlorhydric acid, the excess of acid was driven off, and the manganese was thrown down by bromine in the presence of an excess of acetate of soda as hydrated sesquioxide; this was re-dissolved and precipitated as ammonio-phosphate, and weighed as pyro-phosphate.* The magnesia was separated from the filtrate from the oxide of manganese (after it was first ascertained that this solution was entirely free from manganese) as ammonio-phosphate, and estimated as pyro-phosphate. The water was determined by igniting the powdered mineral in a glass tube closed at one end, about 10 inches in length, with a calibre of ¼ of an inch. The length of the tube effected a complete condensation of the water, which was deposited on the interior 5 or 6 inches from the open end, and the tube and contents, on being weighed, proved to have suffered a loss of less than 1 milligramme by the ignition. The water was then dried out at the ordinary temperature in vacuo over chloride of calcium. To make entirely sure that no boric acid went off with the water, I ignited a portion of the mineral which had previously been thoroughly mixed with about five times its weight of calcined magnesia and then covered with a layer of pure magnesia. The results of this experiment confirmed the water determination made by the above method. The boric acid was determined by Stromeyer's method as borofluoride of potassium. The results of the analysis are:—

	1.	2.	3.	4.	5.	6.	Mean.	Oxygen.
Boric acid	—	—	—	—	—	31·89	31·89	22·82
Manganous oxide	40·08	40·20	40·01	—	—	—	40·10	9·04
Magnesia	17·12	16·76	17·21	—	—	—	17·03	6·81
Water	—	—	—	9·64	9·53	—	9·59	8·53
							98·61	

The analysis shows a loss of 1·39 per cent, doubtless due chiefly to the imperfections of the method employed for determining the boric acid. Calculating the loss as boric acid, the total amount of the acid is 33·28 per cent, and the oxygen ratio for BO_3, RO, and HO is 22·82 : 15·85 : 8·53 or 3 : 2·08 : 1·12. The ratio 3 : 2 : 1, although not according precisely with the analyses, is nevertheless probably the true ratio. It requires a change of but a few tenths of a per cent of water to make this ratio. In fact, in what appeared to be a fresher and less altered specimen than that above analysed, I obtained but 8·93 per cent of water, which would change the amount of boric acid calculated as loss to 33·94 per cent. Correcting the oxygen to correspond to these, we have for BO_3, RO, HO, 23·27 : 15·85 : 7·94, or almost exactly 3 : 2 : 1, or, considering the water basic, a ratio of 1 : 1, thus bring out a most interesting relation between this species and native boric acid, which has the formula $3HO,BO_3$. Sussexite may be regarded an analogous compound, in which two-thirds of the water is replaced by manganese and magnesia, and we may write for its formula—

$$(\tfrac{2}{3}(MnO,MgO+\tfrac{1}{3}HO)3BO_3,$$

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* For details of this admirable method for the estimation of manganese see T. S. Henry, *Philosophical Magazine*, IV., xvi, 197; and W. Gibbs, *American Journal of Science*, II., xliv., 216.

or, if the water be not considered basic, it may be represented by—

$$(MnO,MgO)2BO_3+HO.$$

The former I believe to be the correct view of the composition of the mineral.

In some of its physical and chemical characters, sussexite resembles the mineral Szaibelyite, from southern Hungary. This mineral is found imbedded in limestone in needle-like crystals, has a hardness of over 3, a density of 3, and is a hydrous borate of magnesia. One variety analysed by Stromeyer gave the oxygen ratio of BO_3, MgO, HO, 17 : 14·1 : 4, or of acid to bases including water of 17 : 18·1, or nearly 1 : 1, requiring but a slight change in the determination of water to make this also a mineral analogous in composition to boric acid, with which indeed it is already classified by Professor Dana in the recent edition of his Mineralogy.* Another member of the group is hydroboracite, a hydrous borate of magnesia and lime with the oxygen ratio of BO_3, RO, HO, 4 : 3 : 1, or $(\frac{3}{4}(CaO,MgO)+\frac{1}{4}HO)3BO_3$. Sussexite is at present a rare mineral, but as it occurs in a vein which is extensively mined, there is every reason to hope that it may become more abundant. Its pyrognostic properties are so very characteristic that it may readily be distinguished from any other mineral which it resembles in physical characters. In addition to fibrous willemite, I have also found chrysotile in fine fibres imbedded in the calcite of Mine Hill; it, however, requires but little familiaritty with sussexite to distinguish it at a glance from these species.—*American Journal of Science and Arts*, Sept., 1868.

ON THE MANUFACTURE OF SULPHUR FROM ALKALI WASTE IN GREAT BRITAIN.†

By LUDWIG MOND.

I wish to call your attention to a new industry—the recovery of sulphur from alkali waste—which has made very rapid progress during the last few years, and particularly to the manner in which this manufacture is now extensively carried on in Great Britain.

The importance of this subject has been so ably pointed out to you, in 1861, by Mr. Wm. Gossage, that I may, perhaps, be allowed to repeat his remarks in full. In his very interesting paper on a history of the soda manufacture, after giving in detail the cost of the different raw materials used for the production of a ton of soda-ash, Mr. Gossage went on to say:—

"It will be seen from this table, that 2s. 5d. of the total cost for raw material is incurred for pyrites from which to procure a supply of sulphur; and it is a well known fact that more than nine-tenths of this sulphur is retained in the material called alkali waste, which is thrown away by the manufacturer. Thus is presented a problem, which, if it can be solved, would effect a large reduction in the cost of soda.

"Many chemists, both scientific and practical, have given a great amount of attention to this subject. I have been so unfortunate as to be among the number, as I have devoted a great portion of my time during a quarter of a century, and a large amount of both money and labour, to this hitherto elusive subject."

Having heard so recently this statement from a man of the eminence of Mr. Gossage, who is so well known for the indefatigable energy and perseverance which he has devoted to the many valuable inventions given by him to the world, you will have hardly expected that this problem, in which he and many able men besides him had failed, in spite of all their efforts, was very near a satisfactory solution. But only a few years afterwards we find three different processes for the recovery of sulphur from alkali waste applied in different countries in a very considerable number of works. One of these processes, which is practised at Dieuze, in France, was described to you last year by Mr. Lothian Bell, and I now beg to solicit your attention to a process which is extensively used in this country, and which is connected with my name, because I have been so fortunate in the course of my continued investigation of this subject, which has now lasted for fully eight years, as to hit upon several important improvements on former proposals, which enabled me to turn what had been impracticable schemes into an exceedingly simple and extraordinarily remunerative manufacturing process. I took out a patent for this process in 1863, and I am very glad to be able to state that its merits have been so fully recognised in this country, that it is here used exclusively, and has already been adopted by four of the largest firms, amongst whom are numbered both the founders of the British alkali and the British bleaching-powder trade, while the two other processes mentioned, which have been patented respectively two and three years later than my process have so far only been used on the Continent, where they enjoy the advantage of cheap labour. Only one of them, called Schaffner's process, has been tried on some scale in an English works. It has, however, been quickly abandoned, and my process has been adopted instead.

All the three processes named are based on the following reactions:—

1st. The conversion of the insoluble compounds of calcium and sulphur in the waste into soluble compounds by the action of the oxygen of the atmospheric air.

2nd. The removal of these soluble compounds from the rest of the waste by lixiviation with water.

3rd. The separation of sulphur from the liquors so obtained by muriatic acid, which is employed either as a weak watery solution, or mixed with a solution of chlorides of iron and manganese, as it is obtained as a by-product of the manufctaure of bleaching powder.

A proposal to use these same reactions for the recovery of sulphur from waste has already been made by Mr. W. H. Leighton, in a patent dated October, 1836, and after a long lapse of time, during which they were apparently wholly lost sight of, similar processes have been patented by Messrs. Townsend and Walker, J. L. Jullion, and A. Noble, on the 11th of December, 1860, the 9th of February, 1861, and the 6th of July, 1861, respectively.

All these processes would certainly have separated sulphur from the waste, as had beeen done before by many others, but none of them would have at all met the real difficulty of the problem, which consisted in recovering a sufficiently large amount of sulphur from the waste, and at a reasonable price, so as to make this manufacture a remunerative concern.

In both these respects all these processes, if they ever had been put into practise, would have as sadly failed as have all other proposals in different directions.

In December, 1861, I patented a process in France, which, though still very imperfect, was certainly a considerable improvement in one respect, as it was the first which produced a reasonably large amount of the sulphur from the waste. All the former patents proposed to oxidise the waste only once, by allowing it to stand in heaps or tanks for a considerable time, and having been subsequently lixiviated, the waste was to be thrown away. I pointed out, for the first time, that the soluble compounds of calcium and sulphur produced by the oxidation of the waste increase only up to a certain maximum, and then begin to decrease again if the exposure to air is continued, but that after the removal of these soluble compounds by lixiviation, the lixiviated waste will, on renewed exposure to air, yield a second very considerable quantity of soluble sulphur compounds, and that even a third repetition of this treatment is required in order to exhaust the waste.

It was thus possible to obtain nearly three times as much sulphur from the waste as might have been done by any of the previous methods. Having had unfortunately to deal up to this time only with waste, which by some peculiarity of its manufacture was extraordinarily dense, I failed in all my efforts to oxidise it in heaps of any size, or by forcing air through any depth of it, both of which I tried repeatedly before I took out a patent. I was thus compelled to oxidise in shallow layers on large hurdles, which might have answered in small works such as I had then been connected with, where the wages of skilled workmen were about a shilling a day, and where sulphur at that time had a value of £12 per ton; but the utter impractibility of this mode of oxidation was apparent to me at once as soon as I tried to apply it in this country, where I found the extent of the works, as well as the rate of wages, so very much out of proportion to what I had known before. And very soon I was also perfectly convinced that the waste which is here obtained, being so very much more porous than all I had until then operated upon, would certainly allow of a much simpler treatment, and would in all probability enable me to realise my old favourite idea—namely, to oxidise the waste by forcing air through it, to lixiviate it in the same vessel, and to repeat this treatment until the waste is exhausted without removing it.

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* Dana's Mineralogy, 5th edition, p. 593.

† British Association, Norwich Meeting, Section B.

These views were soon found to be correct; and as I succeeded in oxidising the waste by these means in as many hours as it had previously taken days, I was even enabled to carry out the repeated oxidation and lixiviation of the waste in the same vessels in which this waste had been originally obtained, without increasing the number of those vessels to an excessive extent. Thus manual labour was completely avoided in this part of the process, and the greatest difficulty of the problem happily overcome. The wet alkali waste, as it is obtained in the works, contains not more than 12 per cent of sulphur, only one half of which I have so far been able to recover, while the two other processes are said to recover only 40 to 45 per cent of it. We have thus in the best case to operate three times on nearly 17 tons of waste, in order to produce 1 ton of sulphur. From this you will readily see that any process involving manual treatment of these enormous quantities of waste, and requiring their prolonged stay in the works, would be very expensive and almost impracticable in this country, and that the avoiding of this inconvenience and expense really was the vital point of the question. By my present process, all operations are effected within sixty to seventy-two hours, by means of a fan, which forces the air through the waste, and a pump to lift the liquors obtained, both of which require only an insignificant amount of steam power.

The process is carried out in the following way:—The first product of Leblanc's famous process for the manufacture of soda, called rough soda or black ash, is now almost universally lixiviated with water in an apparatus which was first used for this purpose in Great Britain, and is composed of a number of square iron tanks, connected in a very simple and ingenious way by pipes and taps, to allow the water to enter a tank filled with black ash already nearly spent, and thence to flow through others filled with black ash richer and richer in alkali, until it meets fresh black ash in the last tank, thus becoming an almost concentrated solution of alkali before leaving the apparatus. The alkali waste, or insoluble residue of the black ash, remains thus in these tanks deprived of all alkali, and as it has been immersed in the liquor throughout the whole time of lixiviation, it is consequently obtained in a very porous condition.

These tanks are always provided with a perforated false bottom, and for the purpose of applying my method the space between the two bottoms of each tank is connected with a fan by a pipe with a damper, to allow of the regulation of the quantity of air entering the tank. The pressure of air required never exceeds 6 inches of water, but usually as little as half an inch of water is sufficient, and can thus easily be produced by a common smithy fan.

As soon as the last weak alkali liquor is drained off the waste, the damper in the air-pipe is drawn, and air forced through the waste. The waste soon begins to heat, rising up to 200° F.; it gives off quantities of steam, and becomes gradually covered by spots of a bright yellow colour, which, together with the temperature of the waste and the quantities of steam passing off, enables the workman to judge very well when the proper state of oxidation has been reached. Usually this is arrived at after twelve to sixteen hours' blowing. The oxidised waste is then covered and completely lixiviated with water. As soon as the resulting liquor is drawn off air is again forced through the waste in exactly the same way as before, the waste is again lixiviated, and subsequently this treatment is repeated a third time. The weaker liquors so obtained are passed through one or more tanks filled with oxidised waste, so as to concentrate them, and this can be easily accomplished by a second system of pipes and taps connecting all the tanks in a set, much in the same way as for the lixiviation of black ash, or still more simply by lifting the liquor by a pump and conducting it by a shoot to the other tanks. The whole process of oxidation and lixiviation of the waste, though it is repeated three times, is finished in from sixty to seventy-two hours, and does not require more than one and a half times the number of tanks which are generally used for the simple process of the lixiviation of the black ash. In most works sets of four tanks are employed for this latter purpose, and these have thus to be converted into sets of ten, all of which are to be connected in the usual way by pipes and taps, and are also to be connected to a fan. Four of these ten tanks are always filled with black ash in the course of lixiviation, and the remaining six with waste undergoing the treatment by my process. As soon as this treatment is finished the waste is thrown out of the tanks, and these are filled again with black ash to be lixiviated in the usual way, so that both the process of the lixiviation of the black ash and the extraction of sulphur from the waste are carried on continuously and without interruption. When the waste leaves the tanks, all the recoverable sulphur has been taken out of it; it contains only small quantities of sulphides, which are so enveloped by other compounds that they are no longer acted upon by the oxygen of the air, and can thus no more give rise to the dreadful exhalations of sulphuretted hydrogen, or to the formation of those well-known yellow drainage liquors which have hitherto caused the waste to be so great a nuisance, the one poisoning the air and the other the water, in the neighbourhood of the vast heaps of waste surrounding many works. Almost all the sulphur left in the waste exists in the form of sulphite and sulphate of calcium, which are both quite innocuous, and together with the carbonate and hydrated oxide of calcium, as well as with a little soda. Alumina and soluble silica, which are all to be found in the waste, make this waste a valuable manure for many soils and crops.

The liquor thus obtained, which is usually called sulphur liquor, is of a deep yellow colour, and contains from 4 to 7 per cent of sulphur in solution. This sulphur is present principally in the forms of hyposulphite, polysulphide, and sulphydrate of calcium. Usually the oxidation of the waste is so regulated as to obtain liquors containing as nearly as possible so much oxygen in the form of hyposulphurous acid as is necessary to oxidise both the calcium and the hydrogen existing as polysulphide and sulphydrate. These liquors are run into wooden vessels together with an equivalent quantity of muriatic acid, and steam is at the same time introduced, so as to keep the temperature of the mixing liquids between 140° and 150° F.

The proportions of liquor and acid can be easily and very correctly regulated by the workman according to the colour of the mixing liquids in different parts of the vessel. Black where the liquor comes in, it changes to grey and white, turning into a bright yellow where the acid meets the liquid.

At the temperature mentioned, neither sulphuretted hydrogen nor sulphurous acid are given off in appreciable quantities, but nearly all the sulphur contained in the liquor is precipitated in a very pure state. When the vessel is full of liquid, it is allowed to stand a few hours; the sulphur settles very rapidly to the bottom, and the clear supernatant liquor, which now contains principally chloride of calcium, and generally not more than one-thousandth part of either free acid or hyposulphite of calcium, is then run off.

The vessel is now filled a second and usually a third time with liquor and acid, and the sulphur which has then accumulated in it is drawn out by a door at the lower end of the vessel into a wooden box with a perforated false bottom. Here it is well washed with water, and after having been drained is melted down in an iron pot or pan. It is thus obtained very pure, containing less than 1 per cent of impurity, and surpassing in this respect all brimstone which is imported into this country.

The principal constituents of the liquor are determined in the following way:—

The hyposulphite is tested as usual by a solution of iodine and starch, after addition of acetate of zinc. Another portion of the liquor is tested directly by iodine and starch; the blue colour is then taken away by a drop of hyposulphite of sodium, and litmus and a caustic soda solution is added until all free acid is neutralised.

This free acid is equivalent to the sulphuretted hydrogen in the liquor, and the three tests lead by a very simple calculation to the calcium present as polysulphide. This polysulphide containing usually only little more than two equivalents of sulphur to one of calcium, the test gives also approximately the amount of sulphur in these liquors.

If the proportion of hyposulphite to sulphide has been quite correct, the iodine used for the first test will be one-fifth of the iodine used for the second test. In practice the liquors will of course deviate a little from these proportions; they are, however, kept within so narrow limits, that none of the firms who have so far adopted the process have considered it worth their while to avail themselves of the very simple means which I have proposed for remedying any irregularity, such as keeping a small stock of liquor rich in either hyposulphite or sulphides which the workmen might add in case of any gas being evolved during the precipitation of the sulphur.

The vessel in which this latter process is conducted are, however, always loosely covered in and connected with a chimney, so that any gases which might be evolved by accident are carried off; or they are still better connected with the fan forcing the air through the waste, so that these gases may be absorbed in passing through the waste, and thus the sulphur which they contain may also be saved.

In places where muriatic acid has a comparatively high value, and where bleaching powder is manufactured at the same time, the acid contained in the liquors which are obtained as a by-product in the last-named manufacture may be made available for the separation of sulphur from sulphur liquor, as has already been proposed by Messrs. Townsend and Walker, in 1860, and is now done on an extensive scale at Dieuze, in France.

These liquors containing also chloride of manganese, perchloride of iron, and a little free chlorine, the sulphur liquor ought in this case to contain more sulphides than where muriatic acid is used alone, so that the two last-named constituents may also be reduced by these sulphides. In all other respects I carry on the operation in exactly the same way as described before. The sulphur obtained is of a dark colour, and contains up to 5 per cent of impurities. By these means a second waste and offensive product may be turned to advantage and made comparatively harmless.

The latter object can then still more efficiently be obtained by recovering the manganese also from these liquors. A process used since several months, at Dieuze, effects this only to the small extent of about one-twelfth of the manganese contained in the liquors.

The most satisfactory and complete results in this respect have, however, been obtained long ago by the well-known process of Mr. Dunlop, which has been very largely worked, for a considerable number of years at Messrs. Charles Tennant and Co.'s immense chemical works at Glasgow.

I have still to refer to another method of separating sulphur from sulphur liquor, which I have used before adopting the one already described, and which is still used by many German works. In this method the sulphur liquor is first treated by sulphurous acid, until all the sulphides are converted into hyposulphites. It is then heated by steam to 212° F., and muriatic acid is added by degrees until all the hyposulphite is decomposed. Steam is then continued to be introduced until all the sulphurous acid is driven off, and this is conducted into a second vessel filled with the original liquor, in order to effect there the above-mentioned conversion of the sulphides into hyposulphites. I found, however, that this could only be arrived at with liquors originally very rich in hyposulphite, as, in contradiction to general notions, only very small quantities of sulphurous acid could be obtained by the second part of this method, while large quantities of sulphate were formed instead. The hyposulphite of calcium and muriatic acid form, in the first place, sulphur and trithionate, and the latter is then decomposed into sulphur, sulphate, and sulphurous acid.

Though a considerable saving of muriatic acid could thus be effected, it was by no means an equivalent for the sulphur lost in form of sulphate; and, especially in this country, a saving of muriatic acid would be rather undesirable. The greater its use the smaller will be the enormous quantity still run into the rivers, which, according to the latest official statements, is more than one half of the acid produced, and amounted, in 1866, to above 120,000 tons of anhydrous hydrochloric acid, equal to 360,000 tons of commercial acid of 32° Twaddle.

I am sorry not to be able to give you a more detailed account of the reactions involved in this process. Though the final results are simple, the details of the different changes taking place are very complicated. It is very probable that all the numerous compounds of hydrogen, sulphur, and oxygen are formed at one time or another, as I have been able distinctly to recognise all those which our present knowledge allows us to detect in presence of the others, including persulphide of hydrogen, trithionic, and pentathionic acid. Unhappily, our knowledge of these compounds is very imperfect, but I hope that the prominent part which they now play in an important manufacture may stimulate some of our eminent scientific men to investigate this long-neglected class of bodies. I have no doubt that they would thus confer a great boon upon a new and rapidly-growing industry, and would at the same time obtain results of considerable interest for theoretical chemistry, as these compounds apparently conform but little to modern chemical views.

By the process which I have endeavoured to sketch out to you, fully one-half of the sulphur contained in the waste is recovered, and I have no doubt that this quantity will yet be considerably increased by some further experience, as I have already been able to obtain much more during several consecutive weeks. As you can easily judge yourselves, the cost of plant and the working expenses are very small. A plant for the recovery of 10 tons of sulphur per week can be put up for about £800, and the sulphur can be made at £1 per ton. The recovered sulphur being very pure, it is not used to replace pyrites in the manufacture of soda, but for purposes where Sicilian sulphur or brimstone has hitherto been employed, this Sicilian sulphur having a much higher value than the sulphur in pyrites, and averaging upwards of £6 per ton. And so large are the quantities of brimstone used, that the British alkali trade, in spite of its enormous extent, could only produce a small portion of the sulphur yearly exported from Sicily, which country has hitherto had the monopoly of the supply of this article. According to a trustworthy statement, the total yearly export of sulphur from Sicily has risen to above 200,000 tons—according to another authority, even to 300,000 tons—of which about 50,000 tons are brought to Great Britain. The alkali waste produced from about 400,000 tons of common salt, which are now annually used by the British alkali trade, would yield 40,000 tons of sulphur. The trade is thus in a position by applying this process to the waste yearly obtained, and to only a small quantity of the waste which has accumulated in the neighbourhood of the works to such an alarming extent, to supply this country with all the sulphur which it consumes, and for which it now pays to Italy above £300,000 a year. Considering the great importance of this raw material for many important branches of industry, I will only mention the bleaching of woollen and silk fabrics, and the employment of sulphur for the suppression of the much dreaded disease of the hop-plants, but particularly its indispensability in the manufacture of gunpowder, upon the effects of which the fate, and the independence, and the liberty of nations, to so great and regrettable an extent, still depend. I believe it to be a matter of congratulation to your country that it should possess the means of furnishing its own supply of this valuable substance, and of producing it also at a much cheaper rate than it can be obtained at the best situated mines in Sicily.

The President, Professor **Frankland**, in expressing the thanks of the Section to Mr. Mond, remarked that his communication was one of great importance. In his (Dr. Frankland's) capacity as River Commissioner, it had been his duty to enquire into the great nuisance at present created by alkali waste, which he had found in many cases to be intolerable. He had lately seen a river, called Sankey Brook, which, in consequence of the drainage liquor from the surrounding waste heaps meeting there with hydrochloric acid, which also ran from the alkali works into this river, was almost saturated with sulphuretted hydrogen, and gave off the dreadful smell of this noxious gas for miles.

He had had an opportunity of seeing Mr. Mond's process at work on a very large scale, and to witness its great simplicity and effectiveness, and though he was not competent to judge of the mercantile profit of the process, it was his opinion that the manufacturers were morally bound to adopt it even if it could only cover its cost.

Mr. A. E. **Fletcher**, Inspector of Alkali Works under the Alkali Act, said he very often had reason to complain of the great nuisance caused by the waste, which he believed had increased lately. He had known Mr. Mond's process to work satisfactorily for several years, and the best proof of the practicability of the process he considered to be that several of the largest firms had taken it up successively.

Mr. E. C. **Stanford** stated, that, as an inhabitant of Glasgow, he could tell them a long story of the nuisance which the waste heaps in the neighbourhood had until lately caused in that town. There had been a complete stream of yellow liquor running into the Clyde, meeting there different residues from bleach works, and thus often rendering the otherwise so black stream quite milky, and making the smell of sulphuretted hydrogen very prevalent on both sides of the river. He was glad to be able to inform the section that Mr. Mond's process had been very successfully employed, not only to prevent this nuisance for the future, but also to do away with the present nuisance, as the drainage from the waste heaps was now carefully collected and used to lixiviate the waste which had been treated by Mr. Mond's process, so that the sulphur contained in these drainage liquors was now also turned to account.

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Continued from page 149.)

Comparative Digestibilities of Foods—Functions of Different Foods.

The phenomena of digestion are altogether of a physical and chemical nature; there is nothing whatever of a vital quality about them; for the comminuted food is brought successively under the influence of special solvents furnished by the saliva, the gastric juice, the pancreatic fluid, the biliary secretion, and the intestinal mucus, all of which are associated with a large volume of water. Digestion, indeed, as Berzelius remarked, is a true process of rinsing—the amount of fluid secreted into the alimentary canal and again absorbed from it being, according to the researches of Bernard, Bidder, and Schmidt, not less than three gallons in the twenty-four hours. The following, in fact, are the daily proportions of the several secretions and their solid constituents:—

	lbs.	Solid Matter. grs.	Active Principles. grs.
Saliva	3·54	231	37 of ptyalin.
Gastric juice ..	14·11	2,960	316 of pepsin.
Pancreative fluid..	8·82	6,172	773 of pancreatin.
Bile	3·54	1,233	1,073 of organic ferment.
Intestinal mucus..	0·47	46	28 of ditto.
Total	30·48	10,642	2,227 of special solvents.

All of which, by their special solutive actions on the several constituents of food, rob it of its nutritive quality, and carry it into the circulation.

Each of the fluids so largely secreted into the alimentary canal has its special functions.

The saliva, which is a secretion of many glands opening into the mouth, is a thin glairy liquid, of slight alkaline reaction, except while fasting; and containing about 1 per cent of solid matter—half of which is a peculiar organic body, called ptyalin, and the rest is composed of chloride and phosphate of sodium, with a little carbonate and sulphocyanide. Ptyalin is a nitrogenous substance, of the nature of diastase—the ferment, which in the vegetable converts starch into sugar, and hence it has been called animal diastase by Mialhe, who attaches great importance to it as the principal agent concerned in the digestion of starchy foods—one part of ptyalin, according to him, being capable of converting 8,000 parts of insoluble starch into soluble glucose. Saliva has no chemical action on fat, or fibrin, or albuminous bodies—its real functions being to lubricate the food for deglutition, to carry oxygen into the stomach, and to furnish a solvent for starch and tender cellulose. Those animals which feed chiefly on woody matters, as the beaver, have large salivary glands, and provision is made for a prolonged contact of the secretion with the vegetable tissue.

An artificial saliva may be obtained from seeds which have fermented, and in which the diastase is abundant. Liebig's extract of malt is an example of this; and Mr. Morson has taken advantage of the discovery of M. Mège Mouriès, that the inner layer of bran contains a nitrogenous digestive principle, called cerealin, of the nature of diastase, and has extracted it, and consolidated it with sugar in a preparation which he has named saccharated wheat phosphates. Both of these are aids to the digestion of farinaceous matters.

Gastric juice is a secretion from the entire surface of the stomach. It is a transparent liquid, of a pale yellow colour, and of a saline and acid taste. It is much heavier than water (sp. gr. about 1,020), and it contains from 2 to 3 per cent of solid matter—about 1·7 of which is a remarkable nitrogenous organic body, called by Schwann, its discoverer, pepsin. Its peculiarity is, that in the presence of an acid, it converts almost every description of albuminous and fibrinous matter into a soluble form of albumen, called by Lehmann peptone, and by Mialhe albuminose. It differs from common albumen in many particulars—it is, for example, more liquid; it is not coagulated by heat, nor by weak spirit, nor by acids, nor by most mineral salts; it is not very prone to decomposition; and it is capable of dialysis—that is, of transudation through animal membrane, and, therefore, of absorption, which albumen is not. The digestive power of it is very great, for Wasmann found that an acid liquid containing only 1 part of it in 60,000 of the solution—that is, about 1 grain in a gallon, was capable of dissolving meat; and Lehmann ascertained that 100 parts of the gastric juice of a dog would digest 5 parts of coagulated albumen.

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* The Cantor Lectures, delivered before the Society of Arts.

The nature of the free acid in gastric juice is somewhat doubtful; Lehmann, who has frequently examined it, says it is lactic acid, but Schwann asserts that he has often found free hydrochloric acid. It may be that the chlorides contained in the stomach are partially decomposed by lactic acid, especially during the process of analysis, and thus the hydrochloric acid may be accounted for. When the acid is in too large excess, the digestive action is abnormal, and so also when it is deficient; Lehmann states that the best proportion is when 100 parts of the gastric juice is just neutralised with 1·27 of potash.

Considering the importance of pepsin as a digestive agent, the preparation of it has become a common affair of trade. In France it is obtained from the stomach of the pig by carefully washing it, then scraping off the soft mucous membrane, rubbing it down with a little water, filtering, precipitating the foreign matters with acetate of lead, again filtering, and then precipitating the excess of lead with sulphuretted hydrogen, after which it is allowed to stand, or it is warmed, to get rid of excess of sulphuretted hydrogen; it is then filtered once more, and after carefully evaporating to the consistence of syrup it is consolidated with dry starch. In this country it is prepared from the stomach of the sheep as well as of the pig, and we have our *pepsina ovis* and *pepsina porci*; besides which, the use of lead and sulphuretted hydrogen are avoided by precipitating the foreign matter with alcohol, pepsin being soluble in weak spirit. On the lecture table are specimens of Boudault's pepsin, as well as those of Mr. Morson, of London, Messrs. Turner and Co., and Mr. Claridge, of Warwick, all of which are also in operation, showing their relative digestive powers on animal fibrin.

The pepsin preparations on the table contain varying proportions of starch, as from 29 to 50 per cent; but the digestive power of any specimen may be easily tested by putting a dose of the preparation into a small bottle with half an ounce of water, acidulating with twenty drops of hydrochloric acid, and then adding half a drachm of hard boiled egg chopped small, or the same weight of lean meat, or 120 grains of the fibrin of blood. On standing in a warm place at a temperature of 100 to 110, the digestion should be complete in two hours. Tried in this manner, Dr. Pavy found, some time ago, that nearly all the preparations in common use were inert; not so, however, at the present time, for, as you will notice, digestion is proceeding rapidly.

I am told that the strongest pepsin is obtained from young healthy pigs which are kept hungry, and are then excited by savoury food which they are not allowed to eat; while the influence of it is strong upon them, and the secretions are pouring out in expectation of the meal, the animals are pithed.

Pepsin, like diastase, is rendered inert by a temperature of from 120° to 130° F.; and, therefore, very hot drinks are hurtful.

Pancreatic fluid is a secretion from the pancreas or sweet-bread. Until recently its true digestive functions were not well determined. It is a colourless fluid of a gravity of 1,008 or 1,009. Like the saliva, it is generally a little alkaline, and it contains about 1·3 per cent of solid matter, one-eighth of which is a nitrogenons organic substance of the nature of ptyalin or diastase, and is called pancreatin.

More than twenty years ago, Bernard proved, what Valentin had long before suspected, that the pancreatic fluid was concerned in the digestion of fatty matters; but he fell into error in supposing that its action was to saponify the fat, and to set glycerin free. Here is a specimen of glycerin and of lead-soap obtained from fat upon which the pancreatic fluid had previously acted, showing that saponification had not been effected. The true action of the pancreatic secretion is evidently to break up the large granules and crystals and globules of oil and fat, into myriads of minute particles of from 1-3,000th to 1-15,000th of an inch in diameter. In this way the fat is emulsified and converted into a milky liquid, which mixes freely with water, and passes through the tissues of the intestines into the lacteals. We are indebted for this knowledge to Dr. Dobell, who had long been of opinion that the functions of the pancreas were important in certain diseases, and required elucidation. With the assistance of Mr. Julius Schweitzer, of Brighton, the then manager of the laboratory of Messrs. Savory and Moore, he made a large series of investigations into the properties of the pancreatic secretion, and he found that when the fresh pancreas (and best of the pig) is rubbed down in a mortar with twice its weight of hog's lard, it rapidly emulsifies it; and on adding about four or five times the bulk of water, and straining through muslin, there is obtained a thick milky liquid of the consistence of cream, which gradually consolidates. If this be treated with ether, the pancreatised fat dissolves; and when the ether is separated by distillation, there remains the purified pancreatised fat, which is still miscible with water; in fact, when mixed with four or five parts of water it forms the creamy emulsion which is used dietically and medicinally in doses of a teaspoonful at a time.

The properties of the pancreatic fluid have been well described by Dr. Dobell, in a paper recently read before the Royal Society of London; and it would seem that the fluid has not the remarkable property of emulsifying oil and fat, and so rendering them capable of absorption, but it has also the power of dissolving starch by converting it into glucose. In this respect its action is like that of saliva, but it is much more energetic; for in its fresh state one part of the pancreas will dissolve eight parts of starch, and even after it has emulsified fat it will dissolve two parts of starch. It is, therefore, a powerful agent of digestion, in so far as fat, and starch, and young cellulose are concerned, but it has little or no action on albuminous substances.

I am indebted to Dr. Dobell and to Mr. Morson for the specimens of pancreatin and pancreatised fat upon the table. The first of these preparations is obtained by treating the fresh pancreas with water, and carefully evaporating the solution to the consistence of syrup, and then consolidating it with the flour of malt. Perhaps the dried pancreas, powdered and mixed with malt, would be a stronger preparation.

The bile is a complex liquid, consisting of biliary acids (taurocholic, glycocolic, &c.) in combination with soda. Its reaction is slightly alkaline, and it contains about 14 per cent of solid matter, not less than 12 of which are organic.

The true function of the bile is unknown; perhaps it aids in neutralising the acid peptones from the stomach; perhaps, also, in emulsifying fat; and it may be that it helps the digestion of starchy foods. Lehmann thinks it is a rich residuum from the manufacture of blood globules in the liver, and that it is secreted into the alimentary canal, only to be reabsorbed into the blood. Mr. Lee, also, is of opinion, from his examination of the fœtal liver, that it separates a highly nutritious substance from the portal blood, which is elaborated in the intestines. Its functions, however, are manifestly obscure.

Lastly, the intestinal secretion which is thrown out along the whole course of the small intestines, is, according to the researches of Bidder and Schmidt, a powerful agent of digestion; for it combines the activity and digestive power of all the other secretions—starch, fat, and albuminous substances being all equally well digested by it.

The food, therefore, coming into contact with these special solvents, and being copiously drenched with fluid, gives up its nutritive constituents. Admirable, however, as this provision is for the digestion of food, a considerable portion of useful matter passes through the bowel unchanged; for cellulose, starch globules, and muscular fibre are common constituents of sewage. Dr. Lyon Playfair says that in the case of an adult man, with good digestion, one-twelfth of the nitrogen of the food passes away with the excreta, and others have computed it at an eighth. In a dry state the fæces of man contain about 6·5 per cent of nitrogen, and in the fresh state, 1·7. In Ranke's experiments, it was ascertained that the nitrogen in the fæces was to that in the urine as 1 to 12·5 Much of this is, doubtless, derived from the secretions which have done the work of digestion, and have thus become effete; indeed, Dr. Marcet is of opinion that the alvine discharges are chiefly composed of the residuum of albuminous substances which have been secreted into the bowel for the purposes of digestion. In ordinary individuals they amount to from 4 ozs. to 5·5 ozs. a day—(Wehsurg says 4·6 ozs.; Liebig, 5·5 ozs.; Lawes. 4·2 for a middle-aged adult, and 6·2 for a person over fifty—the mean amount for adult males being 4·2 ozs., and for adult females 1·3 ozs.); and when calculated in a dry state they amount to about 1·1 oz. daily. It would seem, however, that when indigestible and irritating food is used, the quantity of fæcal matter is increased, as if the food was hurried through the intestines without undergoing digestion. At the Wakefield Prison, for example, it was found that when brown bread, containing bran, was given to the prisoners, the weight of the fæces was 7 ozs. per head daily; and the same fact has been observed at the Coldbath-fields Prison.

With this general account of the digestive function of the different secretions discharged into the alimentary canal, we are prepared to inquire into the digestibility of different alimentary substances.

Nitrogenous or proteinaceous, or albuminous substances, which constitute the leading articles of diet, are evidently digested by the gastric juice and the intestinal mucus. In the former case they are converted into acid peptones, of which, accordine to Lehmann, there are several varieties, as albumino-peptones, fibrino-peptones, caseino-peptones, gelatino-peptones, &c., according as they are derived from albumen, fibrin, casein, gelatin, &c., and of these substances the fluid form of albumen is most easily converted; then coagulated albumen, then fibrin, then casein, and lastly, the derivatives of albumen, gelatin, chondrin, and cartilage. The tegumentary forms of albumen, as hair, wool, feathers, &c., being entirely indigestible. Here is an example of the indigestibility of hair—it is a ball of it, obtained from the alimentary canal of a cow, and has come from the calf which the cow has a habit of licking. Serpents and other animals that swallow their prey entire, digest the soft tissues and bones, but they disgorge the hair and feathers untouched.

It is difficult to speak of the comparative digestibility of different nitrogenous foods; for the well-known experiments of Dr. Beaumont on the Canadian with a fistulous opening in the stomach, and even experiments made in bottles with pepsin, do not represent the full and natural conditions of the process: at the present time there are, no doubt, great differences in the digestibility of different animal substances. Dr. Beaumont found, in his inquiries, that soused pigs' feet and soused tripe were the most digestible of all foods, and that boiled tendon of meat was the least digestible. The following, in fact, are the times given by him for the chymification of different animal foods:—

Articles of diet.	How cooked.	Time of chymification.	
		H.	M.
Pigs' feet (soused)	Boiled	1	0
Tripe (soused)	Do.	1	0
Eggs (whipped)..	Raw	1	30
Salmon trout	Boiled	1	30
Venison steak	Broiled	1	30
Brains..	Boiled	1	45
Ox liver	Broiled	2	0
Codfish (cured dry)..	Boiled	2	0
Eggs	Roasted	2	15
Turkey	Boiled	2	25
Gelatine	Do.	2	30
Goose	Roasted	2	30
Pig (sucking)	Do.	2	30
Lamb	Broiled	2	30
Chicken	Fricasseed	2	45
Beef	Boiled	2	45
Do.	Roasted	3	0
Mutton	Boiled	3	0
Do.	Roasted	3	15
Oysters	Stewed	3	30
Cheese	Raw	3	30
Eggs	Hard boiled	3	30
Do.	Fried	3	30
Beef	Do.	4	0
Fowls	Boiled	4	0
Do.	Roasted	4	0
Ducks	Do.	4	0
Cartilage	Boiled	4	15
Pork	Roasted	5	15
Tendon	Boiled	5	30

It is doubtful, indeed, if cheese or tendons are ever digested except in small quantity; and it is evident, from these experiments, as I shall hereafter explain, that cooking has considerable influence on the digestibility of food.

It is a curious problem why the stomach does not digest itself, seeing that it belongs to the class of most easily digestible substances, as tripe. Hunter explained it by referring the protective power to the vital force, for when dead the stomach digests itself in common with the food contained in it; but Bernard's, and Pavy's experiments have proved that this is not the right explanation, for if the legs of living frogs, or the ears of living rabbits, are introduced into the stomach of a dog through a fistulous opening in the side, they digest like other proteinaceous substances. Liebig supposed that the protective power was in the thick mucus which lined the stomach, but Pavey denuded a part of the inner walls of a dog's stomach, and found that the tissue did not digest, but, on the contrary, quickly healed, and he is of opinion that the protective power is in the alkaline condition of the blood, which circulates so freely through the capillaries vessels of the stomach during digestion.

Starchy substances and cellulose are digested by the ptyalin of the saliva, and the pancreatin of the pancreatic fluid, as also by the animal diastase of intestinal mucus. The solution is effected by the conversion of the starch and cellulose into a low form of sugar, called glucose. which is freely absorbed into the circulation, or becomes changed into lactic acid. that serves so important a function in the digestion of nitrogenous matter. The time necessary for the digestion of different vegetable substances, as determined by Dr. Beaumont, is as follows:—

Articles of diet.	How prepared.	Time of chymification.	
		H.	M.
Rice	Boiled	1	0
Apples (sweet and mellow)	Raw	1	30
Sago	Boiled	1	45
Tapioca	Do.	2	0
Barley	Do.	2	0
Apples (sour and mellow)	Raw	2	0
Cabbage with vinegar	Do.	2	0
Beans	Boiled	2	30
Sponge cake	Baked	2	30
Parsnips	Boiled	2	30
Potatoes	Roasted	2	30
Do.	Baked	2	33
Apple dumpling	Boiled	3	0
Indian corn cake	Baked	3	0
Do. do. bread	Do.	3	15
Carrot	Boiled	3	15
Wheaten bread	Baked	3	30
Potatoes	Boiled	3	30
Turnips	Do.	3	30
Beets	Do.	3	45
Cabbage	Do.	4	0

It would be seen from this that the time of digestion is in proportion to the amount of cellulose or woody tissue in the food. No doubt there is a more complete solution of these matters in the small intestines, where the pancreatic fluid and intestinal mucus, aided by the alkaline condition of the fluids, exert the greatest actions on them, but it is very doubtful whether hard cellulose and woody matter are at all digested by man. Even in the case of the pig, whose digestive powers are singularly active, it is thought by Messrs. Lawes and Gilbert, from their experiments on the fattening of animals, that there is little or no digestion of these substances; and, under any circumstances, a very prolonged contact with the secretions is necessary for their digestion. Raw starch will pass a considerable distance along the alimentary canal of man without much change, and it is only towards the end of the small intestines that the starch granules undergo marked disintegration. Those animals which feed entirely on vegetables have always a contrivance for keeping the food for a long time in contact with the secretions. It occurs as the paunch in ruminants, the crop in birds, the large cœcum in rabbits and other rodentia, and as the long alimentary canal of all of them; but even then a large portion of the vegetable tissue passes through the bowels unchanged. Cooking, grinding, and otherwise disintegrating the tissue helps considerably in the digestion of it.

Gum and pectin are probably not digested at all, for as they are unchanged by contact with the secretions, and are incapable of dialysis or absorption, they must pass through the alimentary canal without serving any purpose in nutrition.

Fatty matters are digested by the emulsifying action of the pancreatic fluid; and by being thus broken up into extremely minute globules they are freely admitted into the lacteal vessels; in fact, the emulsified globules of fat are seen covering the villi of the intestines, penetrating their tissues, pervading the subjacent cellular bodies, and thus entering the lacteals; and no doubt the peristaltic action of the intestines contributes largely to this emulsifying process.

Saline substances are generally soluble in water, and are therefore easily absorbed, but when this is not the case, as with the earthy phosphates, they are attacked by the acid constituents of the gastric juice.

And here I may remark that the great aids to digestion are :—

1st. Proper selection of food, according to the taste and digestive power of the individual.

2nd. Proper treatment of it as regards cooking, flavouring and serving it.

3rd. Proper variations of it, both to its nature and treatment, so that the appetite may not fail.

4th. Exercise, warmth, and a genial disposition.

(To be continued.)

NOTICES OF BOOKS.

Scientific Blue Books, No. II. Ninth Report of the Medical Officer of the Privy Council, with Appendix. London.

(Continued from p. 119.)

It has already been shewn in a few words that sufficient guarantees have been given by Dr. Thudicum for the accuracy of his observations, and this is of importance directly to the value of his results. It must be added that verbal descriptions are not exclusively relied upon, but we are further supplied with upwards of twenty diagrams, and these are of two kinds. The well-known method of Bunsen, adopted by him in his researches on Erbium and Didymium, is employed in the first place; thus the intensity of the absorption bands being graduated and fixed by degrees, such bands are diagrammatically represented by a cone of which the base represents the entire marginal width in the spectrum, and the entire cone projects towards the opposite margin proportionately to the blackness of the band. As is remarked in the context the advantage of this consists in its capability of being employed in text books with ordinary letter press, where shading off of degrees of darkness is practically impossible.

The other method is to our thinking more satisfactory, and is after all sufficiently simple; there can be no doubt in the minds of any who will take the trouble of looking at the coloured spectra contained in the report under notice, of its ready application to ordinary text books. A method like this really is a great boon to students, and Dr. Thudicum has fairly earned their thanks for his demonstration of its success. A lithographer prepared sheets with the spectral colour imprinted in the usual succession and proportion; on these are entered the solar lines in the closest approximation to the natural places in the colours possible. If this is not done the slips are fixed upon a rack of parallel lines representing the spectrometer scale, the ends of the spectrum being first accurately adjusted. The slight drawback is to express the amount of shading belonging to each band; for this the estimate of the eye is the sole guide. A slip thus once carefully prepared may be of course reproduced, and printed by the chromo-lithographer; and to avoid the trouple of printing them on the paper of the book, these slips may be pasted in the properly left blank intervals.

It seems to us that similar slips may be similarly introduced into text books by authors; and observers by following these directions will be able to record their results for future reference.

As the chief interest of all these experiments turns upon the urine of cholera patients, it is necessary to follow Dr. Thudicum in his remarks of—first, the quantity, secondly, quality of the secretion in the disease.

As the complete suppression of the urinary secretion in collapse, lasting for hours or days, is one of the most striking and peculiar features of cholera, so its re-appearance is amongst the earliest and most auspicious signs of beginning recovery. The first secretion mostly contains the evidence of the mechanical obstruction of the minute channels of the kidneys, and of the general death of the epithelia of the urinary passages. It also contains the sign of continued resistance to the blood current through the kidneys in the form of transuded albumen of the blood. Further in many cases it carries small quantities of peculiar abnormal ingredients, which may perhaps be products or remnants of processes engendered by the cholerаic process in the blood.

Out of upwards of thirty cases of cholera in which an opportunity for examining the urine was afforded, only about eighteen yielded first or early urine of reaction with characteristic properties of that stage. In several of these eighteen cases the only specimen obtained was taken from the body after death.

The first urine passed by persons recovering from collapse was mostly small in quantity, as little as six cubic centimetres being observed. After the first excretion, which afforded one limit of the measure of the secretory activity compared to time, several hours frequently elapsed before a second excretion affording the other limit took place. This yielded generally a larger amount of fluid than the first, but its measure remained greatly below the normal standard. When the urine excreted during the first twenty-four hours after the re-establishment of secretion was united and measured, it was sometimes found as low as 70 cubic centimetres, being only one-tenth of what would have been excreted in acute febrile diseases, and only one-twentieth of the normal standard of health.

To this diminution of the urinary water corresponded a great diminution in the amount of the principal ingredient, urea. In one case the total quantity of urea excreted during the first twenty-four hours after the secretion had begun amounted to only 0·9 grammes, being only about one-thirtieth part of the secretion which a healthy individual of the same weight would have produced during the same time. The urine was dilute, the urea being to water in the relation of 1·4 to 98·6 In health the urea is in round numbers 2 per cent of the urinary water, and in febrile conditions it rises to 3 and 4 per cent. There is consequently no condition of health or of febrile disease, and as far as our present knowledge goes, no other condition of body whatsoever in which chemical change as expressed by the excretion of urea may be so much diminished as in cholera.

The first urine mostly contained appreciable quantities of uric acid, but not more than would correspond to a feeble proportion in normal urine. In some cases the acid was spontaneously deposited in the crystalline state. Oxalic acid, which may be termed an accidental ingredient of normal urine, and which obtains great pathological importance in cases where its lime salt manifests a disposition to crystallise and form concretions in the body, was mostly present in first cholera-urine to the amount of several centigrammes. Of the inorganic salts chlorides were either absent or present in traces, phosphates and sulphates much diminished. The colour of first urine was mostly pale yellow, sometimes, however, saturated yellow, rarely dark. It was turbid by suspended formed ingredients, and appeared of a darker colour when these matters were removed by filtration. The colour was due to ordinary urochrome, and perhaps in part to the admixture of one or two different bodies which with acids yield blue and red products, and which have therefore been designated as urocyaninogen and urorubinogen. Albumen in small quantities was mostly present, rarely absent. Sometimes there were sporules single and double, and more or less developed fungi. These signs of decomposition, together with abundance of vibriones, were the more developed the more the neutral or acid reaction had passed into the alkaline, and the more the presence of ammonia carbonate was indicated by the deposition of crystals of triple-phosphate. Lime phosphate in needles and dumb-bells was also observed in cases where the decomposition had gone farther, mixed with spinous globules of soda urate. In such cases the pus cells formed the usual ropy masses of adhesive mucus.

In the torpid, tepid, and febrile stages the urine assumed properties and was excreted in quantities corresponding on the whole to the thermic conditions of the body, and the rapidity of pulse and respiration, in such a manner as on general pathological grounds from a knowledge of these conditions might have been predicted.

The earliest urine voided by choleraic patients entering upon the stage of reaction, not rarely contains a peculiar principle, which has the property of generating a blue colouring matter, when the urine is cautiously boiled with a sufficient, but not excessive, quantity of nitric acid.

This production of a blue matter from the urine of cholera patients was first observed by Gubler (*Gaz. Méd. de Paris*, Dec. 16, 1854). The usual colour of the urine which gave him the test was very pale yellow. He found the blue more evident when impure nitric acid, containing nitrous acid, was used. He never found any green tinge, but the blue persisted for some time and then faded. He believed that there was some analogy between this matter and the colouring matter of bile.

These observations were a year later confirmed by H. Osborn, (*Medical Times and Gazette*, March, 1855, 307,) and Lauder Lindsay (*Ibid.*, May, 1855, 460.) Osborne observed that the urine of a cholera patient recovering from collapse had a dark colour and turbid appearance, was acid, and of specific gravity 1020. The addition of a little pure nitric acid changed the colour to reddish, then deep violet, and a blue powder was ultimately deposited. When nitric acid containing nitrous was used, effervescence was produced, and a brown precipitate subsided, in which the microscope discovered some blue specks; the supernatant fluid remained of a straw-colour instead of a deep violet. Hydrochloric acid acted exactly like nitric acid in producing the blue precipitate and violet colouration. The blue matter appeared soluble in alcohol. On adding a solution of potash to the blue precipitate, the solution gave, with a persalt of iron, a pale blue; and with a protosalt of that metal a greenish precipitate, insoluble in hydrochloric acid. Sulphate of copper threw down a reddish brown precipitate from this solution by potash. The urine of the patient gave a less amount of blue precipitate as convalescence became established.

Subsequently Lindsay, on evaporating a mixture of the first urines of four collapse cases entering upon reaction, observed that as the fluid reached the boiling point a copious scum of a beautiful Prussian blue colour formed on the surface. Microscopically it seemed to consist wholly of urates having a blue tinge.

LABORATORY NOTES.

SUPPORTS FOR EUDIOMETERS.

SIR,—It may be a matter of interest to readers of the Chemical News engaged in the analysis of gases by Bunsen's methods, if I place on record a device to which I have had recourse for the support of the eudiometers. Six months ago I used with more or less success wooden screw clamps, but in many instances such supports have no claim to the title, and are often, from their construction, quite unfitted for the purpose intended. I need not enumerate the defects in the so-called universal holders, light at its foot and weak in its joints, a very contradiction of its profession. I shall pass over the support figured on page 22 of Bunsen's "Gasometry" as being a fixture to the table, and remark that I prefer freely to suspend the eudiometer so as to allow the instrument to assume a vertical position. This is easily and satisfactorily accomplished as follows:—Two pieces of thin copper binding wire of equal length are placed side by side and twisted together in the middle so as to form a circular loop; this is done by aid of a glass rod; the length of wire so twisted may be 5 millimetres. The four free extremities are next somewhat flattened, so that when placed over the head of the tube they shall lie closely to the glass at equidistant points; in this position they are to be carefully bound to the tube with waxed thread for a length of 10 millimetres.

So secured the wire will remain attached under a strain of 14 pounds. The support, from which the tube is suspended by a steel hook, consists of a cross bar of wood or metal resting on two uprights, the feet of which are heavy and fit closely against the ends of the trough. One of the uprights should be cut away in such a manner as to allow a tube to be passed through, that it may lie in the felt-covered groove. From the cross bar hang several hooks of lengths adapted to the various eudiometers. The arrangement as here described is one I have used for the last six months. Its simplicity and the ease with which the tubes are placed in position and removed are its chief recommendations. Again, several tubes, if required, can be suspended in the same manner; the menescus of each in no way obscured by shadows thrown from its neighbour.

The only point requiring alteration is to carefully centre the loop of copper wire before the binding is made secure. Some apology is perhaps due for bringing into prominent notice a matter so simple. I must, however, allow the substance of the letter to plead its own cause at the bar of opinion.—I am, &c.,

P. Holland.

September 22.

CORRESPONDENCE.

WANKLYN & CHAPMAN'S "WATER ANALYSIS."

To the Editor of the Chemical News.

Sir,—The review of our book on "Water Analysis," with which you favoured us and your readers generally last week is mixed up with other matter which requires some notice from us.

As to the review properly so-called, there is no necessity for us to discuss it at all, and we shall content ourselves with expressing our sense of the unusual magnitude of the space in the columns of your valuable journal which has been devoted to it. Neither is there the smallest necessity for us to defend ourselves from the charge of over-hasty publication, which is levelled at us by the reviewer, nor from that of bringing out "raw, incomplete, and sometimes inaccurate results;" all this must be regarded as a compliment, the like of which is occasionally paid us by certain chemists whose activity does not take the direction of the original research.

But either from inadvertence or from some other cause, the reviewer has been betrayed into some misstatements. Thus our strictly formal quotation from Dr. Noad's book is described as a copying;—"copied from Dr. Noad's Qualitative Analysis," writes our critic. In literary circles the use of such an expression is, we believe, restricted to the description of a quotation or paraphrase made without acknowledgment. Moreover this quotation is merely subsidiary, not being, as the reviewer would seem to imply, the description of the details of the soap-test in the form which we prefer to recommend for general adoption.

On the subject of the controversy respecting Dr. Frankland and Mr. Armstrong's method, which our critic regards as "very elaborate and most elegant," fault is found with us for not being able to assert that we have tried it. However, the set of test-determinations, published by Dr. Frankland and Mr. Armstrong, for the purpose of exhibiting the capabilities of their method, and which does exhibit it as having arrived at so high a pitch of perfection as to be affected by an average error of only half a milligramme of organic carbon or nitrogen, in a litre of water, relieves chemists from the duty of examining it experimentally for themselves. At any rate under these circumstances no blame can rest on us who do not question the possibility of reaching this degree of precision, but who have simply pointed out that a litre of most kinds of natural water contains *less* than half a milligramme of organic nitrogen.

The reviewer is in error in the account given by him of the origin and history of our ammonia process. It did not originate in the oxidation process, as our reviewer represents it to have done; neither is it quite correct to say that it was first announced on the 20th of June, in a paper read to the Chemical Society. Before that date it had been given very explicitly, but in a rudimentary state, in the pages of "The Laboratory."

Our reviewer's account of the contents of our various papers bearing on this subject is, for the most part, a misrepresentation diversified by positive mis-statements. We will not waste your valuable space by entering into detail, but, should the errors of our critic take root in the chemical mind, may possibly refer to them at some future time. Mr. Dugald Campbell's results were contradicted in "The Laboratory" within a fortnight of their publication. They were again denied emphatically at a meeting of the Chemical Society, and were not maintained even by himself. They were subsequently denied by Mr. Philip Holland in the pages of this journal, and have never been confirmed by any one.

With regard to the advice given to us, no doubt very kindly, towards the end of the review, "not to imagine that chemists are prejudiced against it" (our ammonia process), "because they hesitate to accept evidence so inconclusive," &c., we have to say that our complaint is of another kind—viz., that it has been precipitately adopted without being either acknowledged or understood. In the interval between the reading of our paper to the Chemical Society and the publication of the number of the Chemical Society's Journal containing the description of our process, chemists were to be found, who, trusting to their recollection of what had been read to them, or, depending on a reporter, did not scruple to undertake the working of our ammonia process for the Government, without our co-operation or knowledge.—We are,

Your humble and obedient servants,

J. Alfred Wanklyn.
Ernest T. Chapman.

Laboratory, London Institution,
Sept. 28, 1868.

[We take a somewhat unusual course in printing the above review of our review, and we do so, firstly, because the subject it refers to is of great importance, and secondly, because we are anxious to enable our readers to form as impartial an opinion as possible on the question at issue.

It is scarcely worth while to answer in detail all the petulant objections taken by our correspondents. We did write "copied" instead of "quoted," and if the "literary circles," to whose somewhat vague tribunal we are referred, decide that copied means pirated, we must bow in meek submission: in the meantime we will take leave to consider the objection a quibble. The various chemists whom our irritable authors attack can very well defend themselves, and to them we leave the task. We are not much afraid that the high reputation which has hitherto marked the names of Frankland, Odling, and Campbell, will suffer much diminution, even from the assaults of these redoubtable champions.

As for our reviewer, and the aspersions cast upon his veracity, he exhibits, we are grieved to say, anything but a contrite spirit, and even aggravates his offence by reiterating all his statements. He urges that his account of the history of the ammonia process is, in the main, perfectly correct; that the papers which appeared in "The

Laboratory" contained no notice of the process as it was afterwards published, and in particular no allusion to permanganate of potash; that the earlier papers contained important statements which were contradicted in the later ones; and generally, that the original publication was in an eminent degree "raw, incomplete, and inaccurate."

He has sent us, in justification of his opinions, the following quotations from some of the authors' published papers, and we are so far influenced by them as to refrain for the present from holding him up to general execration:—

Wanklyn. *Laboratory, May 11, 1867, p. 98.*

"The organic impurities to be dreaded in a water are nitrogenous. During the evaporation of a water these nitrogenous compounds give up their nitrogen in the form of ammonia. Distil therefore a given volume of the water in a retort and estimate the ammonia in the distillate, and you have a trustworthy measure of the much-dreaded organic impurities in your water."

Wanklyn, Chapman, and Smith. *Journal of the Chemical Society,* xx., 448.

"Direct experiments in which a *known quantity* of urea, gelatin, and albumin were taken have shown that *all the nitrogen* present in these substances is obtainable in the form of ammonia when they are subjected to the treatment about to be described (the ammonia method), and has disclosed the very singular fact that boiling with a caustic alkali liberates one-third of the nitrogen, both of albumin and of gelatin in the form of ammonia, and that a subsequent boiling with permanganate of potash liberates *the other two-thirds.*"

Wanklyn. *Journal of the Chemical Society,* xx., 594, 595.

"Perfectly pure urea in perfectly pure distilled water may be boiled for a long time with carbonate of soda, or with potash, without giving off ammonia."

"The same urea dissolved in a town water containing ·07 milligrammes of albuminoid ammonia per litre gave a slow evolution of ammonia, becoming after a time quicker."

"Boiling with caustic potash and then with permanganate of potash, gives off only about *two-thirds of the ammonia which albumin contains.*"[*]

Passages like these speak for themselves, and we can only conclude by reiterating our regret that scientific men of such undoubted abilities should labour so hard to prove to the world that they are as wanting in scientific caution and accuracy as they are in the more important attributes of good taste and good temper.—*Ed. C.N.*]

MISCELLANEOUS.

India-Rubber Sponge.—One of the most ingenious and useful applications of india-rubber which we have seen for a long time has been forwarded to us by Messrs. P. B. Cow, Hill, and Co. It consists of a highly porous cellular mass of vulcanised india-rubber. The material is at present only supplied in oblong rectangular tablets stiffened at the back by a plate of solid india-rubber. This renders it more effective for cleaning paint, windows, &c., but somewhat detracts from its use as a substitute for a bath sponge. If the makers would supply the material in oval tablets or larger masses without any solid stiffening it would form a most perfect imitation of sponge, and would have the great advantage of being almost indestructible. It can be used either with or without soap.

NOTES AND QUERIES.

Claret Colour.—A correspondent asks for a formula for a good claret colour for printing on woollen cloth,—a steam colour.

Setting Worsted Tapes.—Will any of your readers have the kindness to inform me of the best method of setting worsted tapes previous to dyeing, to prevent them from doubling up or shrinking when they are boiled in the dye cistern.—R. B. C.

Sulphocyanide of Ammonium.—In Mr. Peter Spence's notice of this substance, inserted in your valuable journal of the 4th ult., he states—"Some twenty years ago it was the custom to *saturate* the ammoniacal water of the gas manufacture with sulphuric acid, then to evaporate and crystallise." The phrase "to saturate the ammoniacal water of the gas manufacture with sulphuric acid" is as incorrect as statements contained in his paper on the "Smoke Question," which appeared in the Chemical News of November 2nd, 1866.—J. C. Lee, Jessamine Villa, Ashton-on-Mersey, near Manchester, Sept. 28th, 1868.

Peaty Soil.—In answer to the query in your journal two weeks ago, respecting certain peaty lands that were ploughed and drained and failed to be productive, notwithstanding a large quantity of organic matter as humus being present; it is too common a mistake that the presence of humic acid makes a soil productive; it has often a tendency to be injurious, by keeping iron in a protoxide state, and locking up some of the other inorganic constituents in a soil. Indeed this is a question of very great importance, as few can believe the narrow limit that often exist between a productive and unproductive soil. I have had acid soils that a grain or two of mineral alkali to the 1000 of soil has increased the productiveness from 40 to 50 per cent. Your queryist wishes to know what are the elements likely to be exhausted in the peaty soil—ammonia, nitrogen, phosphates, &c.? Without a full analysis of the soil, the kind of manure applied, with the crops taken off, and yield, it is not easy to say what is wrong. It is not likely that any of the substances named are wanting, as phosphates, in all likelihood, would be applied, and rain and snow would give ammonia; ammonia and nitrates, added too freely, would make such a soil unproductive. I have no doubt but were they applying some quick lime, and, if in the neighbourhood of blast furnaces, they were putting a heavy top-dressing of finely-ground slags, the soil will be productive. —A Practical Farmer.

TO CORRESPONDENTS.

W. M. B.—We should recommend Bauerman's work on "Iron Manufacture," recently reviewed in our columns. In a few months the English adaptation of Kerl's "Metallurgy of Iron and Steel" will be published.

L. Lawson.—Add strychnine to iodide of methyl. This will readily yield the iodide of methyl-strychnine, and from this the sulphate can be easily prepared.

Theo. J. Schuster, Philadelphia.—The patent is not yet out; a very good article may be made by adding carbolic acid to ordinary soap, slightly increasing the quantity of alkali, if necessary, to dissolve the acid. You will find Reimann's "Handbook of Aniline," (published in America by Wiley and Sons, of New York), give you the fullest information on the subject of the aniline dyes. There is a German periodical devoted to the subject of dyeing, but not one in English.

A Subscriber.—Dissolve the coin in nitric acid, evaporate the solution to dryness, and fuse the mixed nitrates of silver and copper in a porcelain dish over a lamp until the nitrate of copper is all decomposed. Then dissolve in water, filter, and crystallise.

S. A. S.—Dr. Hassall published a book some years ago on the subject of the "Detection of adulterations in articles of food."

Reader.—You have omitted something in the question. You cannot make sulphate of silver by precipitating nitro-sulphuric acid with dry sulphate of soda.

Berlin Black.—A correspondent asks how to make Berlin black for fire-grates?

C. Meymott Tidy, M.B., M.A.—The secretary did not reply to our circular, so we were not aware of your being joint lecturer on chemistry with Dr. Letheby.

E. E.—A basic salt is one which contains more equivalents of the base, and an acid salt more equivalents of the acid, than are required to form a neutral salt. Thus basic acetate of lead is acetate of lead containing an excess of the metallic base.

Hopeful.—Write to the Registrar, 17, Savile Row, London, W.

R. H. Rowell.—When the manuscript is ready we shall be happy to give advice on the subject.

Apparatus.—"Nindex," who asked a question on this subject some weeks ago, is referred to 44, Berner Street, where he may probably meet with what he seeks.

W. C.—Eliot and Storer's Inorganic Chemistry. Published by Van Voorst.

Communications have been received from Messrs. Wanklyn and Chapman (with enclosure); W. Leslie; H. Tate; W. Little; J. Dixon; Gehe and Co., Dresden (with enclosures); E. Kernan; W. E. Buckhurst; H. Corry; R. H. Rowell; E. Ellick; S. Mellor; W. Howell; J. Wilson; Professor Maynard; F. Field; Reynell and Son; D. Forbes, F.R.S.; R. Spice, Jun.; Longmans, Green, and Co.; Dr. Bingley (with enclosure); C. H. Hutchinson (with enclosure); Harvey and Reynolds; T. Coomber; C. L. Colthouse; A. Smith; T. P. Miller (with enclosure); W. Hall; G. W. Robinson (with enclosure); Dr. S. Muspratt; Archibald Walker and Co.; C. Greville Williams, F.R.S.; Muspratt, Bros., and Huntley; G. Jarmain; C. M. Tidy, M.B., M.A. (with enclosure); W. Hunter; Williams and Norgate; C. R. A. Wright; Mitchell and Co.; G. Evett; F. Lennon (with enclosure); and J. C. and J. Field.

BOOKS RECEIVED.

Thorley's Illustrated Farmers' Almanack and Diary for 1869.

A Practical Guide for the Perfumer. Edited from Notes and Documents of Messrs. Debay, Lunel, &c., with additions by Professor H. Dussauce.

On the Chemistry of some Carboniferous and Old Red Sandstones, by J. Wallace Young.

On a Simple Method of Exhibiting the Combination of Rectangular Vibrations, by W. Fletcher Barrett.

The British Army in 1868, by Sir Charles E. Trevelyan, K.C.B. London: Longmans.

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[*] The italics are ours.—*Ed. C.N.*

THE CHEMICAL NEWS.

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ON STELLAR SPECTROMETRY.*

By PADRE SECCHI.

Fraunhofer was the first who analysed with the prism the light of some stars, and discovered in them lines analogous to those which he had discovered in the sun. Donati, an Italian astronomer, now at Florence, resumed these researches and extended their field; several astronomers followed, amongst whom the celebrated Mr. Huggins, to whom we owe a description of the spectra of a great number of stars, and the application of the principle of determining the substances contained in a star from the black lines of absorption, which we see in its spectrum, as was proposed by Kirchoff. Mr. Huggins also made the wonderful discovery of the gaseous state of the nebulæ.

The field opened by these discoveries was immense, and I tried to glean some ears in it. In the first epoch of these studies the principal stars only were examined, the imperfection of the instruments not allowing the examination of all the heavenly host. An optical combination which I had the good fortune to discover enabled me to extend the researches to the whole of the visible stars, and even to several ones only telescopic, which conceal perhaps the greatest mysteries of this kind.

This optical combination consists in a single prism of that kind which is used for direct vision combined with a cylindrical lens. This combination allows us to employ the full light of the star not diminished by absorption, as in common spectroscopes, due to the slit and to the several surfaces through which the light must pass. The image of the star in this system is found in the focus as a luminous line of white colour if there is no prism, and with the prism the image is decomposed into a series of luminous lines arranged according to their refrangibility, the interruptions due to the discontinuity of light appearing as black lines.

In these images the relative position of the lines can be measured with a common screw micrometer, and their absolute position can be obtained by comparison with fundamental stars, whose lines, on account of their intensity, can be fixed in an absolute manner relatively to chemical substances by a common slit spectroscope. This comparison and measurement is rendered more easy by an improvement introduced in the instruments, by means of which I can see the direct image of the star together with the spectrum. The super-position of this image on a spectral line in a part of the field of the telescope marked by a wire, is susceptible of great nicety in measurement, and supplies very sure results. This is, in a few words, the apparatus employed in my researches, to which this last year I have made a considerable improvement by employing an eye-piece made with cylindrical lenses only. With these such a strength of light is obtained that I have been able to observe the spectrum of the stars of seventh and eighth magnitudes, of course quite invisible to the naked eye.

Let us come now to the results. For this purpose many hundred stars were passed in review, of every magnitude to the sixth. A catalogue of the chief of them has been made and partly published in the said memoirs. The work of the last year, yet unpublished, has been especially the examination of the red stars of smaller magnitude, of which a particular research was instituted, but which was superseded after the reception of the catalogue of Professor Schjellerup; all the objects contained in this catalogue (printed also in Chambers's beautiful treatise on Astronomy) have been examined to the eighth magnitude, beyond which limit my instrument cannot give a good spectrum.

The principal results and conclusions to which I have arrived are these:—

1st. All the stars in relation to their spectrum can be divided into four groups, for which the type of spectrum is quite different. The first type is represented by the stars Sirius, by Vega, or *α* Lyræ, and by all the *white* stars, as *α* Aquilæ, Regulus, Castor, the large stars in the Great Bear, *α* excepted, &c. The spectrum of all these stars consists of an almost uniform prismatic series of colours, interrupted only by four very strong black lines as they are given in the figure; of these black lines the one in the red is coincident with the solar line C of Fraunhofer, the other in the blue coincides with the line F, the other two are also in the sun, but they have no prominent place. These lines, however, belong all to hydrogen gas, and the coincidence of these black lines with those of the said gas has been, by careful experiments, made already by Mr. Huggins, and begun also lately by myself. In *α* Lyræ the coincidence is found to be perfectly accurate. Mr. Huggins, however, finds a little difference in Sirius, for which we may account in another way, as I will expose presently.

This first type of stars is very numerous, and embraces almost one-half of the visible stars of the heavens. We observe, however, some difference in individuals, so that in some stars the lines are longer, and in others narrower, which may be due to the thickness of the stratum which has been traversed by the luminous rays. The more vivid stars have other very fine lines occasionally visible; but which are not characteristic of the type-form. In this type the red colour is very faint in proportion to the blue, violet, and green, so that the colour of the star is tending to the blue hue, and occasionally to the green. Of this last kind is the group of the large constellation of Orion and its neighbourhood.

The second type is that of the yellow stars, as Capella, Pollux, Arcturus, Aldebaran, *α* Ursæ Majoris, &c. These stars have a spectrum exactly like that of our sun—that is, distinguished by very fine and numerous lines; these appear occasionally as a uniform spectrum when the state of the atmosphere is not good, but in general the lines may be distinguished very easily. A fuller description is useless, since the spectrum of the sun is very well known. The only thing which deserves particular attention is that, in this class, occasionally the magnesium lines are very strong, so that it produces very strong bands, and the iron lines in the green are in some very powerful.

These stars can be distinguished even without the prism by the difference of colour and richness of yellow, which contrasts so much with the first type. Stars of the second type are very numerous, and embrace almost the other half of the stars.

The third and very remarkable type is that of orange or reddish stars. These have as a prototype the stars *α* Herculis, *α* Orionis, Antares, *θ* Ceti, *β* Pegasi, &c. The spectrum of these stars shows a row of columns at least eight in number, which are formed by strong luminous bands alternating with darker ones, so arranged by their shadow as to represent a series of round pillars, exactly as architects are accustomed to draw a colonnade. *α* Herculis is exceedingly remarkable in this regard; the other stars are more or less deeply divided into pillars, but it is quite impossible to describe the beauty of the appearance which is visible in a telescope on a fine night. All the pillars are generally resolved into smaller and finer lines, very sharp and brilliant, more or less resolvable in different stars. I have carefully drawn, after actual measurements, the appearance of *α* Orionis and *α* Herculis, and in the printed memoir Antares and Aldebaran. In these stars some of the divisions of the pillars correspond to some capital lines of Fraunhofer as D and *b*, but others, as C and *f*, although falling very near, do not coincide.

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* British Association, Norwich Meeting, Section A.

The presence of hydrogen is, however, sure; the lines *c* and *f* having been found in the principal of them. The divisions of the pillars after many measurements have been found to agree perfectly in all these stars, so that this type is perfectly constant and characterised. In my catalogue twenty-five of these most interesting objects are registered, and I do not imagine that I have exhausted this number.

A very interesting feature connects this type with the preceding one.

I must remark, first, that we ought to distinguish between lines and bands of shadow. The lines are narrow, sharp, and neat, the bands are shaded, although, perhaps, each band may be composed of very small lines; the aspect for our instruments (as we use them now) is that of a more or less continuous shade. This shade is analogous to that which is produced on the sun's spectrum by the vapours of our atmosphere when it is near the horizon.

Now it is a very remarkable fact that the actual type in the preceding seem to differ from one another not in the metallic lines, but only in the nebulous bands. So, for instance, the spectrum of Arcturus and Aldebaran present the same metallic lines as *α* Orionis, but this has bands in addition. The feature, however, is so peculiar in its whole that a different type must be constituted. It is to be remarked, also, that all the pillars have their luminous side towards the red, while the shadowed side is towards the violet. This difference is only substantial, as we shall see presently.

The fourth type is not less remarkable. This is the result of a day's research on the telescopic stars of red colour. Some of these are very small, and none of them exceed the sixth magnitude. This is the reason why, in my first memoir, I limited the spectra to three types only, being only engaged in larger stars. The spectrum of this type consists only of three large bands of light, which alternate with the dark spaces so distributed as to have the most luminous side towards the violet. A very fine prototype of this is seen in the small star of the Great Bear, placed $\alpha = 13^\circ\ 38'\ 5''$; $\delta = 46^\circ\ 15'$. But occasionally there are in the yellow and red numerous interruptions, which divide the large luminous spaces into smaller ones, as in $\alpha\ 22^\circ\ 52'\ 5''\ \delta = -25^\circ\ 55'$ and $\alpha = 6^\circ\ 26'\ 9''\ \delta = 38^\circ\ 33'$. A great part of the red stars of the catalogue of Lalande, and of that of M. Schjellerup belong to this or to preceding type. Of this last class I have found seventeen very remarkable objects. The simple colour also here may be a guide in the research, since some of these are like drops of blood in the field of the telescope. It is to be noticed that the line of the magnesium *b* falls exactly almost at the end of the second luminous band in the green, but the full aspect of the spectrum does not justify the presence of such metal, but rather of a gas like carbon which has luminous bands corresponding almost to the dark of the stars but not exactly.

I do intend, however, to fix the nature of the substances, since I have not yet taken sufficient comparative measures of them. But it seems to me that we are authorised in supposing these stars to be in a different condition to others; perhaps partly in the gaseous state, or at least surrounded by a very large atmosphere, different certainly from that of the others.

The most striking object for its singularity which I have met in this examination of the heavens, and which is quite unique, with the exception of a very faint companion, is *γ* Cassiopeiæ. This star showed to me for the first the lines of the hydrogen in a luminous state, exactly opposite to the dark one of all the others, and is quite the reverse of all those of the first type. The star *β* Lyræ has the same feature but in a very faint degree.

We have, therefore, without doubt, in the heavens a grand fact, which is the fundamental distinction of the stars in a small number of types, which opens the field to very many cosmological important speculations.

Secondly, another grand fact which was brought out from those researches was, that the stars of the same type are crowded occasionally in the same space of the heavens, so the white stars are thickly gathered, in the Leo, in the Ursa Major, in Lyra, Pleiades, &c., while the yellow ones are very frequent in Cetus, in Eridanus, Hydra, &c. The region of Orion is very remarkable for having all through, and in the neighbourhood, green stars of the first type, but with very narrow lines and with scarcely any red colour. It seems that this particular kind of star is seen through the great mass which constitutes the great nebulæ of Orion, whose spectrum may contrast with the primitive spectrum of the stars. Sirius is perhaps too near us to be affected by this influence. The distribution of stars seems to indicate in space a particular distribution of matter or of temperature in the different regions.

Thirdly, a very remarkable conclusion arrived at is that all the spectra of the third and fourth type belong to variable stars. The representative of these is the wonderful (Mira) Ceti. This has been carefully examined and found that, even when it is only of the seventh magnitude, it has the same spectrum as the typical, but only reduced to its few bright lines; *α* Orionis is in the same condition, *α* Tauri or Aldebaran, and Antares, this year appeared to be smaller and of a more red hue than in the past year, and in the first appeared traces of columns which were not seen the year before: so that it is evident that the change of these stars depends on a periodical change which happens in their atmosphere. It is not so, however, with Algol, which has the very same spectrum of the first class or type in every stage of greatness, which induces me to believe that there the variation is produced by the passage of an opaque body passing between us and the central star, giving thus an example of eclipse of a fixed star by his own obscure planet.

Finally, a very delicate question I proposed to myself to be resolved by spectral analysis; this consists in ascertaining whether the star has a proper motion from the displacement of the lines, which ought to take place in the spectrum by the combined motion of the star and the propagation of light. From this new kind of aberration it would be easy to ascertain if a star has a motion whose velocity should be five times that of our earth around the sun. The star *α* Lyræ examined in this manner has not given any such displacement, so that it appears not to have such a motion. In some other stars I have found that there is a little displacement, as in *ε* Ursæ Majoris, but this seems especially due to the different breadth of the hydrogen line in the star and in the compared spectrum. I have employed for this study the comparison of the direct image of the stars with its own spectrum, but I have found no such quantity of displacement. But my first researches of this kind started from the supposition that in Sirius there was a perfect coincidence of the lines of the hydrogen with those of the stars; now I am told that your celebrated countryman, Mr. Huggins, has found a little difference for Sirius. As his opportunity of comparisons is greater than mine, I leave to him the solution of this question, satisfied that the first proposal of this method for determining proper motion of the stars which I made since the year 1863 has been well received by such a competent judge.

I will conclude with a few words on nebulæ, and especially on that of Orion. I have the honour to present a drawing of it made with the best care, which is intended to show how far we may see with a single nine and a half inch object glass, leaving to your gigantic instruments to penetrate more deeply into these wonderful objects. I shall say only that in the other side of the galaxy I have examined several nebulæ and found them to have the same spectrum as *θ* Orionis, only a difficulty arose in my mind about this subject, which is as follows: How can it be that while the hydrogen gas has so fine and rich a spectrum we do not see in the nebulæ anything except the single line *f*. I undertook therefore a kind of photometrical discussion of the intensity of luminosity of the different lines which constitute the spectrum of this substance, and the result was that in diminishing by an absorbing screen and single reflections the light, we could reduce the spectrum to a single line *f*, as we see in the nebulæ. Even hydrogen burning at common temperature has not given any line beyond this after reflexion.

The difficulty is, therefore, completely removed, being only a question of intensity of light.

Here you see that the matter is not exhausted: we want yet to make a more thorough review of our discovery to settle many points in question. It is to chemical men to resolve some of these difficulties; the astronomer can only here walk after the lamp of chemistry. We had already a great satisfaction in seeing just lately that brilliancy of a comet was due to the rays of carbon. Ere long we shall more accurately know what nourishes the light and heat in so many bodies which are scattered in the profundity of space.

ON A

NEW REAGENT FOR ESTIMATING THE AMOUNT OF CARBONIC ACID IN BICARBONATES CONTAINED IN NATURAL WATERS.

By M. Ch. LORY.

In the course of my late experiments upon the natural waters of Isère, I was greatly interested in the ingenious method pointed out by M. Barthélemy (*Annales de Chimie et de Physique, Janvier*, 1868), of estimating the amount of carbonic acid in the bicarbonates contained in natural waters, by means of a standard solution of mercurial nitrate, containing an excess of nitric acid. The use of this reagent is easy, and gives, in many cases, very satisfactory results; but owing to the insolubility of the protochloride of mercury, this method loses its exactness when the waters contain evident traces of chlorides, and becomes inapplicable as soon as the proportion of chlorides increases to several centigrammes per litre. It also appears to be unadapted to the treatment of waters highly charged with sulphates, or containing organic matter, &c. My endeavour has been, while preserving the principle of the method, to replace the mercurial salt by a reagent capable of more general employment, and not subject to exclusion in similar cases. After several experiments I have discovered such a reagent in solution of phosphate of copper dissolved in a slight excess of chlorhydric acid, obtained by precipitating the bichloride of copper with common phosphate of soda, washing the precipitate, suspending it in water, and dissolving it in chlorhydric acid, added drop by drop. If this reagent be poured into a water containing alkalies or alkaline earths in the state of carbonates or bicarbonates, these bases will saturate the chlorhydric acid in the first drops which are thrown in, and the phosphate of copper will form a bluish cloud in the water; as more is poured in this turbidity dissolves in the excess of acid, and the exact moment when the water again becomes quite limpid must then be seized. By stopping at this point, the quantity of reagent employed will evidently be proportional to the total equivalent of the bases, and consequently to the quantity of carbonic acid combined with them as bicarbonate. This I have ascertained with regard to admixtures of waters containing different proportions of bicarbonates, either with each other or with distilled water; I have also proved that the standard given by the reagent does not change when the water is previously saturated with free carbonic acid gas.

To obtain the standard of the reagent I dissolved in 1 litre of distilled water 0·265 grammes = 1-200th of an equivalent of carbonate of soda, dry and pure, passing through it a current of carbonic acid, to produce a bicarbonate. The copper reagent which I employed was such as to require exactly 4·4 c.c. to create in 1 decilitre of water the reaction described. For the treatment of every other water, it will be found sufficient to multiply by $\frac{2 \cdot 2}{4 \cdot 4}$ = ·5, the number of cubic centimetres employed for 1 decilitre, to obtain the number of centigrammes combined per litre; the employment of a measure graduated in 5ths of cubic centimetres will give precisely similar results.

This reagent is unchangeable, and easily prepared, and is effectual, no matter what quantity of chlorides, sulphates, &c., be contained in the water; it may even be employed for the alkalimetrical estimation of very dilute liquids; but it should be remarked that the reaction is much more exact with bicarbonates, than when the bases exist as neutral carbonates or free alkalies. By combining this quick and simple test with the test by the standard solution of soap, both in the natural water and also in the same water after boiling, the most important elements for the appreciation of its ordinary and hygienic qualities will be obtained.

The chlorides may be quickly estimated by adding to 0·1 litre of water a small quantity of chromate of potash, and then a very dilute standard solution of nitrate of silver containing 4-100ths of an equivalent per litre, until the yellowish straw colour of the liquid, at first rendered merely opaline by the formation of chloride of silver, begins to turn reddish from the admixture of the chromate of silver. With regard to sulphates their presence is discovered qualitatively by chloride of barium; but in order to estimate quantitatively by means of this reagent, the amount of sulphuric acid, it is necessary to employ the method pointed out by Mohr, which, although longer and indirect, will, however, give very precise results.

ON THE CHEMISTRY

OF SOME

CARBONIFEROUS AND OLD RED SANDSTONES.*

By J. WALLACE YOUNG.

Sandstone is generally understood to consist of quartz grains—popularly called sand—bound or cemented together into a more or less compact mass, the cementing material consisting of such substances as the carbonates of iron, lime or magnesia, clay, and silica. It is not my intention at present to enter into the origin of sand, but rather to draw attention to the nature of the cementing and colouring materials of some sandstones of the carboniferous and old red formations, and more particularly those found in the neighbourhood of Glasgow.

On the Nature of the Cementing Material.—Sandstone may have been cemented together by the decomposition or re-arrangement of some of the constituents previously in the sand, or by the addition of such substances as carbonate of lime and oxide of iron, deposited from springs. Professor Church, in some interesting notes on the recent formation of some rocks, observes, "that at Bude Haven, Cornwall, and elsewhere, coarse grained sand is in many cases being cemented together by the action of the water of land springs containing carbonic acid, which, percolating through the sand and dissolving the fragments of shells contained therein, the carbonate of lime is subsequently at some other point slowly deposited as the carbonic acid escapes, thus forming a cementing material for the sand."

In cases where the quantity of carbonate of lime is large, it may probably have been derived from adjacent limestone rocks.

When we place a few fragments of a sandstone in hydrochloric acid and apply heat, we are enabled at once to determine whether the cementing material is acted on to any considerable extent. If of a siliceous or felspathic nature, it will be scarcely, if at all, affected; if, on the other hand, it consists of such substances as carbonate of lime, or peroxide of iron, it will be removed by the action of the acid, and the sandstone will be more or less disintegrated. After treating the sandstone with acid, it is necessary to make a careful examination of the residual sand. In the analyses which accompany this paper, I have, in general, indicated the nature of this sand in the different specimens examined. In most cases it appeared to consist of quartz grains, sometimes smooth and round, at other times small and angular, usually accompanied by a finely divided substance, which, in fact, possessed all the properties and composition of clay. I have frequently found as much as 7 or 8 per cent of this clayey matter. Fragments of mica were almost invariably present, and always of the white variety; I have only twice observed any of the black variety, and this seems a little curious when we consider that it occurs so very frequently in those rocks from which the sand must have been derived. It has been suggested that as black mica seems to be more susceptible of change, it may either have been decomposed, or converted into the white variety.

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* Transactions of the Geological Society of Glasgow.

Occasionally rounded fragments of felspathic or other analogous rocks were found accompanying the quartz. When we find quartz alone present, it is probable that the rocks from which those sandstones were derived, have undergone greater decomposition than those in which felspathic or other fragments are found. The former may have been solidified, decomposed, and re-solidified several times, until the only substances which point to the former presence of other matter, are the fine clay and fragments of mica. In the latter, on the contrary, we find some of the other rock fragments still entire, proving that they have not undergone the same extensive decomposition. I am here taking it for granted that the sand has been primarily derived from those crystalline rocks containing free silica.[*]

It is often rather a difficult matter to indicate the conditions under which certain sandstones have been formed. Take, for instance, the hard fine white sandstone which is so extensively quarried at Bishopbriggs. According to the analysis given elsewhere, it consists of very fine round grains of quartz, a little mica, and some fine white clay, the whole cemented together by 33·49 per cent of carbonates. Amongst these we find carbonate of iron to the extent of 6·62 per cent; now, it is perfectly certain that atmospheric air (or oxygen) cannot have been present during its deposition, or else the iron would have been peroxidised and the carbonic acid separated. The same remark applies to all those cases in which carbonate of iron is present. Generally speaking, I find that those sandstones which contain carbonates are harder the greater the quantity present. This agrees with the observations of Bischof.

I shall now proceed to give a short account of a few of the sandstones examined.

CARBONIFEROUS SANDSTONES.

Braidbar Quarry, Cathcart.—Some parts of this sandstone are curiously streaked in all directions with peroxide of iron, presenting often a most beautiful appearance. It is moderately fine grained, and not very hard. No effervescence with HCl.[†] The peroxide of iron was determined in one portion, and amounted to 1·52 per cent. The residue consisted of rounded quartz grains, a few plates of mica, and a considerable quantity of fine clay; this last seemingly acted the part of cementing material. At a part of the same quarry wrought underground, there is a marked difference in the nature of the cementing material; it consists of 13·24 per cent of carbonates, as follows:—

Carbonate of Lime . .	5·27 per cent.
,, of Magnesia. .	3·04 ,,
,, of Iron. . .	4·93 ,,

residue, quartz grains, a little mica, and clayey matter.

Varieties from Newton Coal Pits, near Cambuslang.—(*a.*) The curious brown bituminous sandstone, with the regular white streaks running through it, which has been described in the *Transactions of the Geological Society of Glasgow*,[*] is found here. It possesses a faint odour like paraffin oil, and benzol dissolves out most of the bitumen. It effervesces slightly with HCl. Residue, quartz grains, a little mica, and a considerable quantity of fine white clay.

The white streaks are in soms pieces remarkably straight, and occur at regular distances; in other pieces, however, they become gradually closer and more confused, running into one another, become abrupt, and then cease, the sandstone being then of a uniform brown colour throughout. Large portions, evidently of the same sandstone, are white, with a single brown bituminous streak here and there. I cannot agree with the explanation of these phenomena given in the paper previously referred to. The bitumen appears to me to proceed rather from the simple decomposition of vegetable matter under certain peculiar circumstances, but I am quite unable to account satisfactorily for the remarkable regularity of the white lines.

(*b.*) A beautiful micaceous sandstone; splits readily into very thin layers, the surfaces of which are very thickly covered with plates of mica and purple-coloured spots of peroxide of iron. Effervesced with HCl, the acid removed some carbonate of lime, a little alumina, a large quantity of peroxide of iron, and slight traces of magnesia. Residue, white, contains quartz, mica, and fragments of some felspathic or other analogous rock, and a little clayey matter. Solution of carbonate of sodium extracted a very little silicic acid from the residue.

No. 1. This variety is white and friable; effervesced slightly with HCl, which extracted 3·44 per cent of substance, the composition of which is shown is No. 1 of the following table:—

	1	2	3	4	5
Carbonate of Lime....	2·06	20·06	14·60	13·87	17·97
,, Magnesia	traces	14·78	11·21	6·51	14·59
,, Iron	1·38	—	5·51	6·07	·97
Peroxide of Iron	traces	4·4	—	—	2·25

No. 2 is the soluble portion of some large red lumps found in the foregoing sandstone; they are very hard, and easily separated from the white. Residue, colourless quartz grains, and a little clayey matter.

No. 3. Another variety; greyish-coloured, and rather hard. Residue, quartz grains, pretty large and transparent.

No. 4. Colour, white; fine-grained; hard. Residue, quartz grains, with a small quantity of clay.

No. 5. Colour, brownish-red, speckled with white; hard. Residue, quartz sand with a little mica.

These varieties are principally interesting on account of the large and varying quantities of the carbonates of iron and magnesia which accompany the carbonate of lime. It may perhaps be necessary to state here, that the foregoing table, and other subsequent ones, display the composition of the substance removed from each sandstone by HCl, the residual sand forming the remainder of the 100 parts.

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[*] M. Daubrée, by subjecting fragments of granite, &c., to rotation in a cylinder in presence of water, found, after a certain time, that the quartz was reduced to the state of fine sand, and the felspar to a very fine mud, the water at the same time becoming highly charged with alkaline silicate. It would thus appear that by the simple rubbing together of grain against grain, the felspar being reduced to a minute state of division, is decomposed by the water, alkaline silicates being removed in solution, and the silicates of alumina left as clayey matter. This appears to explain satisfactorily the reason we find felspar grains so seldom present, but almost always clayey matter accompanying the quartz.

[†] I have used the symbol HCl for hydrochloric acid for the sake of brevity.

[*] (Vol. xiv., p. 35). On some peculiar varieties of Old Red and Carboniferous Sandstones from the neighbourhood of Glasgow. By John Young.

Varieties from Bishopbriggs Quarries.

	1	2	3	4
Carbonate of Lime	5·0	17·32	6·87	10·92
,, Magnesia	2·66	9·55	3·75	traces
,, Iron	2·38	6·62	2·79	·93
Peroxide of Iron	·76	·88	·67	·48

Nos. 1 and 3. From quarry near railway station. Colour, whitish; fine-grained; moderately hard. Residue, quartz grains with fragments of mica, and some fine white clay.

No. 2. From adjoining quarry; a very hard variety; colour, white; fine-grained. Residue, very fine rounded grains of quartz, with a few plates of mica, and a considerable proportion of fine white clay.

No. 4. From the side of a trap-dyke.

Nos. 1, 2, and 3, are extensively used as a building material.

From a Coal Pit near Bishopbriggs.—This sandstone contains layers of a brown impure iron ore running through it; contains 16·07 per cent of protoxide of iron = 25·89 per cent of carbonate, also some carbonate of lime and magnesia, peroxide of iron, and a trace of alumina, which were not estimated. Residue, quartz grains, with fragments of mica. It would appear that a deposition of iron ore was occurring simultaneously with the formation of this sandstone. Another specimen of a very similar nature and appearance, from near Edinburgh, contained 12·30 per cent of protoxide of iron = 19·81 per cent of carbonate.

Eastfield, near Cambuslang.—The portion examined was not very hard. Colour, greyish, owing to the presence of a little carbonaceous matter, effervesced with HCl, which removed 7·53 per cent of substance as follows:—

Carbonate of Lime .	. 4·80 per cent.
,, of Magnesia.	. 1·93 ,,
,, of Iron. .	. ·80 ,,

Traces of manganese and peroxide of iron. A large round mass found in this sandstone, and which it appears the quarrymen call "bastard whin," was simply a very hard cream-coloured piece of sandstone. Effervesced with HCl, which dissolved 29·26 per cent of carbonates as follows:—

Carbonate of Lime .	. 15·42 per cent.
,, of Magnesia.	. 9·84 ,,
,, of Iron. .	. 4·00 ,,

The difference in hardness is owing to the increased amount of carbonates. These large round masses are very frequently found in quarries. The sand of which they are composed appears to be similar to that of the surrounding rock, the only difference, as far as I could see, being in the amount of cementing material.

Abbey Craig, near Stirling.—Colour, white; coarse-grained, and not very hard. HCl extracted 4·33 per cent of substance—

Carbonate of Lime .	. 2·00 per cent.
,, of Magnesia.	: ·48 ,,
,, of Iron. .	. 1·85 ,,

The residue contained a considerable quantity of fine white clay.

The Wallace Monument is, I understand, partly built of this stone. As it is in many parts so extremely coarse-grained, and owing to the nature of the cementing material, I cannot believe that it will possess the durability requisite for a memorial of this kind.

Craigleith, near Edinburgh.—Fine-grained, hard; colour, white. Gives a very slight, but decided effervescence with HCl. The acid solution contained small quantities of peroxide of iron and lime. Residue, quartz grains, with a little mica. The cementing material appears to be felspathic matter. In other sandstone from Mugdock, Locherdinan, near Strathblane, Carluke, &c., the cementing matter was also of a similar nature.

The copper ore, which was formerly wrought at Gourock, occurs disseminated in a conglomerate sandstone. The pebbles are principally quartz, and the cement appears to be of clayey or felspathic nature.

Slamannan.—Colour, greyish-white, very hard; contains the remains of shells (*Anthracosia*). HCl removes 60·20 per cent.

Carbonate of Lime .	. 51·06 per cent.
,, of Magnesia.	. 3·78 ,,
,, of Iron. .	. 4·39 ,,
Peroxide of Iron and Alumina	·97 ,,

Residue, fine quartz sand, with some clayey matter, and plates of mica.

The red sandstone which overlies the carboniferous strata in the West of Scotland effervesces freely with HCl. The acid solution contains large quantities of lime and peroxide of iron, and a little magnesia. Residue, not quite colourless, and not wholly quartz sand; a considerable quantity of white mica is present, and a few fragments of the black variety.

Giffnock Quarry, near Pollokshaws.—Colour, whitish; fine-grained; moderately hard. HCl removed 10·02 per cent of the substance—

Carbonate of Lime .	. 4·78 per cent.
,, of Magnesia.	. 2·49 ,,
,, of Iron. .	. 2·36 ,,
Peroxide of Iron . .	. ·39 ,,

Residue, very fine quartz sand, with some mica, and a little clayey matter.

A rounded mass of the so-called "bastard whin," nearly 7 feet in circumference, was found lying in this quarry. It was extremely hard, and it was with difficulty that fragments sufficient for analysis could be obtained.

Colour, white; fine-grained. HCl removed 39·83 per cent of carbonates—

Carbonate of Lime .	. 19·53 per cent.
,, of Magnesia.	. 10·62 ,,
,, of Iron. .	. 9·65 ,,

Residue, similar to the foregoing.

A part of the surface of this lump was very much decomposed, being of a deep brown colour and quite soft, from the decomposition of the carbonate of iron.

OLD RED SANDSTONES.

Falls of Clyde, Lanark.—Colour, purplish red; coarse-grained; effervesced briskly with HCl. The acid solution contained a large quantity of peroxide of iron and lime, some protoxide of iron and alumina, and a trace of magnesia. Residue, fragments of different coloured quartz, felspar, a little mica, and a few dark-greenish grains.

From the Tweed at Dryburgh.—Colour, deep red; fine-grained; considerable effervescence with HCl. The solution contained a large quantity of lime and peroxide of iron, with considerable traces of magnesia and protoxide of iron. Residue, not quite colourless, and not wholly quartz, small quantities of clay and mica being present.

Finnich Glen.—Colour, reddish; brisk effervescence with HCl. Some portions of this sandstone are much harder than others; the following table shows the composition of the part removed by the acid from the two varieties:—

	Harder Portion.	Softer Portion.
Peroxide of Iron .	2·10 per cent	. 1·27 per cent.
Carbonate of Lime:	16·60 ,,	. 10·95 ,,

Residue, not quite colourless, principally quartz, with a little felspar. No mica observed in portion examined.

Port-Glasgow.—Colour, greyish white; rather hard. HCl removes 16·40 per cent of substance—

Peroxide of Iron and Alumina .	·30 per cent.
Carbonate of Lime	. 16·10 ,,

Considerable tracts of magnesia. Residue, chiefly quartz, not quite colourless, a little mica and fine clay. This sandstone occurs in regular beds, alternating with a reddish marl or limestone.

Loch Thom, above Greenock, Ballagan Series.—Colour, dirty white; moderately coarse-grained and hard. The cementing material is in this case carbonate of lime, with considerable traces of protoxide of iron and magnesia.

From Arbroath.—Colour, pale reddish; coarse-grained. HCl removed 23·18 per cent of substance—

Peroxide of Iron and Alumina	5·22 per cent.
Carbonate of Lime	17·06 "

Traces of protoxide of iron and magnesia. Residue, not quite colourless, fragments of quartz and felspar. A considerable quantity of white mica was present, accompanied with a few fragments of the *black* variety.

Many other varieties of sandstone from Largs, Dumbartonshire, and other districts, invariably contained carbonate of lime in conjunction with a ferruginous clayey matter.

Conglomerate, Callander, Perthshire.—Hard; appearance, red. Consists of various pebbles such as porphyry, quartz, greenstone, mica slate; a slight effervescence was perceived with HCl. The cementing material is of a felspathic nature, produced evidently by the decomposition of some of the ingredients.

Two varieties of red sandstone (Permian?) from Annan, Dumfriesshire, contained no carbonates, the cementing material being a ferruginous clay.

From Gourock.—Colour, whitish; rather hard. HCl removed 26·87 per cent of substance—

Alumina and Peroxide of Iron.	·32 per cent,
Carbonate of Lime	26·55 "

Residue, quartz sand, with some felspar and a few particles of mica.

From Bute.—Colour, red. Effervesced with HCl, which removed the following:—

Peroxide of Iron	2·07 per cent.
Carbonate of Lime	6·07 "

Traces of magnesia and alumina. Residue, colourless, chiefly quartz grains, with some fine white clay.

From Dumbartonshire.—Coarse-grained; colour red; contained mica. HCl removed the following:—

Peroxide of Iron	2·70 per cent.
Carbonate of Lime	9·60 "

From Lossie Mill, Forfarshire.—Colour, greyish; fine grained. Effervesced with HCl. The solution contained considerable quantities of protoxide of iron and lime, with some alumina and peroxide of iron. The residue consisted of insoluble silicates, quartz, and fragments of mica. A boiling solution of carbonate of sodium extracted a considerable amount of soluble silicic acid from the residue.

Caithness Flagstone.—Used as a paving material; colour, greyish; irregular bands of quartzoze matter running throughout. Effervesced with HCl. The acid solution contained lime, magnesia, alumina, and protoxide of iron. The residue consisted of insoluble silicates, quartz, and fragments of mica. Solution of carbonate of sodium extracted a considerable portion of soluble silicic acid.

The two foregoing sandstones differ entirely from all those previously examined; they appear to consist of—

Carbonates.	Insoluble Silicates.
Soluble Silicates.	Quartz, and fragments of Mica.

In general appearance and character they approach rather to a clayslate than to sandstone.

On the Colouring Matter of Sandstones.

Iron, in one shape or another, from its wide diffusion, is unquestionably one of the most common colouring matters of sandstone. It produces the various shades of brown, red, purplish red, crimson red, &c., so frequently observed. These shades of colour appear to be due to peroxide of iron alone, and their difference of tint may, perhaps, be owing partly to varied degrees of hydration, according to the circumstances under which they were produced. It is well known that artificially prepared peroxide of iron differs much in shade, according to the source whence it was obtained.

The red colour of sandstones seems not to depend so much on the amount of peroxide of iron present as upon the way in which it occurs. Upon examination, each little quartz grain of which the sandstone is composed, will be found to have a slight coating of the red oxide, and which in most cases can be readily removed by HCl. A small portion of peroxide of iron thus appears to be able to colour a considerable quantity of sand.

A sandstone which may appear almost quite white to the eye often contains more peroxide of iron than a red one; but upon further examination, it will generally be found that it proceeds from minute specks or spots, disseminated throughout the mass. This, of course, applies exclusively to peroxide of iron, as large quantities of protoxide of iron may exist without colouring the sandstone.

In many red sandstones we find white blotches and spots, round rings, &c. These appear to be due to the removal of some of the iron oxide. The following analyses may serve to illustrate this:—

	1		2		3	
	A Per Cent.	B Per Cent.	A Per Cent.	B Per Cent.	A Per Cent.	B Per Cent.
Peroxide of Iron	·14	·76	·65	2·20	·37	1·75
Carbonate of Lime	—	—	13·30	12·72	2·22	1·15
Carbonate of Magnesia, Sand, &c.	—	—	trace	trace	—	—

No. 1. *From Port-Glasgow.*—Colour, deep red, with large irregular white blotches; not very hard. No effervescence with HCl. Residue, quartz grains with a little mica. Peroxide of iron in "A" the white, and "B" the red portion.

No. 2. *From Dumbartonshire.*—Colour, red, with large white blotches; moderately hard.

"A." Substance removed from the white part by HCl.
"B." " " red "

No. 3 *From Largs.*—Fine grained; moderately hard.

"A." Substance removed from the white part by HCl.
"B." " " red "

Residue, quartz, with some felspar, and a few fragments of mica.

The only explanation which has been given of these phenomena, as far as I am aware, is the presence of some organism in the sand, the decomposition of which has reduced the peroxide to the protoxide of iron, which would be subsequently removed as carbonate, by water containing carbonic acid percolating the mass.* The carbonate of lime would be, of course, added subsequently.

Silicates of iron frequently colour sandstones green, but I have not met with any of these. The only green coloured sandstone which has come under my notice is a fragment I picked up on the sea-shore at Portobello, near Edinburgh, the colour being due to a carbonate of copper. The following is the centesimal composition:—

Alumina and Peroxide of Iron	·30
Carbonate of Lime	6·50
Carbonate of Copper	3·40 (CuO. 2·5 per cent.)
Loss on drying at 100° C.	1·35
Quartz Sand, &c.	88·15
	99·70

Sandstones of different shades of brown and black are often found in our coal measures; the former generally proceeding from bituminous, and the latter from carbonaceous, matter.

The peculiar striped variety of sandstone referred to above must be classed with these, but the exact method by which the alternate layers were produced must still be matter of conjecture.

The principal results of my experiments lead to the following conclusions:—

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* Mr. James Bennie, who has so diligently investigated the surface geology of Glasgow, informs me that he has frequently observed sand in contact with decaying roots or twigs to be partially bleached.

1st. That in the greater number of sandstones examined, the cementing material consisted of carbonates.

2nd. That very considerable quantities of the carbonates of iron and magnesia frequently accompanied the carbonate of lime, although no definite ratio seems to exist between them. That the carbonates were chemically combined in some way is, the author thinks, probable, as weak acids caused only a very feeble effervescence in those sandstones where any considerable quantity of the carbonates of iron and magnesia was present, differing entirely from the very brisk action of a similarly diluted acid where carbonate of lime alone existed.

3rd. That these sandstones generally speaking were harder the greater the proportion of carbonates.

4th. Mica was found to be present in nearly all those examined, and, with two exceptions, was always of the white variety.

5th. Soluble silicates were only found in three sandstones in any quantity; all three belonged to the Devonian system.

6th. Insoluble silicates which, for want of a better name, I have in general called felspathic or clayey matter, appear to be almost always present in more or less quantity.

7th. The round masses so frequently encountered in quarries in our neighbourhood, and known as "Bastard whin," by whatever cause produced, appear to be simply parts in the sandstone rock which have become excessively hard from an increased proportion of carbonates, and are thus more or less easily separated from the surrounding rock.

8th. That the different red shades of colour observed in sandstones, more particularly in those belonging to the Devonian group, appeared to be due solely to peroxide of iron, and that the white rings and spots so frequently met with have resulted from the reduction and subsequent removal of the greater part of this iron.

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Continued from page 163.)

Functions of Different Foods.

Functions of Food.—Although much attention has been directed to this important subject—viz., the immediate and remote functions of food—yet it must be admitted that the difficulties of the question have not been surmounted, and that we are hardly able to particularise the phenomena which are incidental to its transformations. We can see clearly enough that its ultimate destiny is the manifestation of force—the letting loose of the cosmical agencies which were bound up in it—when, by undergoing oxidation, it returns more or less completely to its original forms—carbonic acid, water, and ammonia; but how and where these changes occur, and what are the subsidiary phenomena and concurrent functions, besides those of common motion and animal heat, are as yet almost unknown to us. Nor are we sufficiently acquainted with the special attributes of the principal constituents of food, as the albuminous, the fatty, the farinaceous, the saccharine and the saline; for although the well-known opinions of Liebig, with regard to the dynamic or force-producing functions of the nitrogenous or plastic elements of food, and of the thermotic or respiratory powers of the carbonaceous have been generally received, yet there are abundant reasons for believing that both of these classes of food may perform exactly the same functions in respect of the development of force; and, again, it is more than probable that the nitrogenous or plastic constituents of food may, like the carbonaceous, be oxidised and consumed in the living body without ever entering into the composition of tissue. In these respects, therefore, their are great points of divergence from the views of Liebig.

Looking, however, at the proximate elements of food, it may, perhaps, best serve our present purpose if we inquire generally into the several functions of water, albuminoid compounds, fatty substances, farinaceous and saccharine matters, and mineral salts.

1st. Water is unquestionably of great physiological value, for as much as 75 per cent of the muscular tissue of the animal frame is composed of it; and of the 20 lbs. of blood which an average-sized adult contains in his body, about 15½ lbs. are water. It is computed, also, that not less than 30 lbs. of fluid ebb and flow daily from the blood and alimentary canal by secretion and absorption. Bidder, indeed, estimates that about 28·6 lbs. of chyle and lymph are carried daily by the thoracic duct alone into the circulation—a quantity of fluid that amounts to about one-fifth of the entire weight of the adult human body; and then with regard to the excretions, we find that rather more than 1 lb. of water is exhaled daily by the breath, about 1¾ lbs. by the skin, and not less than 2¾ lbs. by the kidneys, making altogether about 5½ lbs. per adult daily.

These results indicate the importance of water in the functions of the animal body. It serves, indeed, to dissolve the food and carry it into the circulation; to effect the distribution of it throughout the system; to dissolve effete matters, as the metamorphosed constituents of worn-out tissues, and so convey them out of the body; to establish the chemical activity which is necessary for nutrition and decay; to combine mechanically with the tissues and lubricate them, so that they may perform their functions; and lastly, to evaporate by the air-passages and skin, and thus maintain the proper temperature of the body.

2nd. The second constituents of our food—viz., albuminous, nitrogenous, or plastic matters—were once, and until very recently, thought to have the sole function of constructing and repairing the muscular parts of the body; and having so entered into the composition of tissues, their oxidation and decay were attended with manifestations of force which were the working powers of the animal machine. "We see," says Liebig, "as an immediate effect of the manifestation of mechanical force, that a part of the muscular substance loses its vital properties—its character of life; that this portion separates from the living part, and loses its capacity for growth and its power of resistance. We find that this change of properties is accompanied by the entrance of a foreign body (oxygen) into the composition of the muscular fibre; and all experience proves that this conversion of living muscular fibre into compounds destitute of vitality is accelerated or retarded according to the amount of force employed to produce motion. Nay, it may safely be affirmed that they are mutually proportional; that a rapid transformation of muscular fibre, or, as it may be called, a rapid change of matter, determines a greater amount of mechanical force; and conversely, that a greater amount of mechanical motion (of mechanical force expended in motion), determines a more rapid change of matter." He further remarks that "the amount of azotised food necessary to restore the equilibrium between waste and supply is directly proportional to the amonnt of tissue metamorphosed," that "the amount of living matter, which in the body loses the condition of life, is, in equal temperatures, directly proportional to the mechanical effects produced in a given time." That "the amount of tissue metamorphosed in a given time may be measured by the quantity of nitrogen in the urine;" and "that the sum of the mechanical effects produced in two individuals in the same temperature is proportional to the amount of nitrogen in their urine; whether the mechanical force has been employed in voluntary or involuntary motions; whether it has been consumed by the limbs, or by the heart and other viscera."

These are the generalisations of Liebig, and they go to show, not only that the dynamical action of the animal body depends wholly on the transformation of muscular tissue, and may be measured by the quantity of nitrogen excreted as urea; but also that no oxidation of nitrogenous matter can take place until it has passed from the condition of food to tissue, and has thus become organised. According to this view, the mechanical force of the human machine is derived entirely from its own combustion, and not from the oxidation of matters contained in the food.

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* The Cantor Lectures, delivered before the Society of Arts.

For some time past there have been suspicions that this view of the case is not correct; and the doubts of physiologists have been strengthened by the circumstance that great labour might be performed for a short period without the use of a nitrogenous diet; and that while there was always a relation between the quantity of nitrogen in the food and that excreted as urea, there was no such relation between the dynamical actions of the body and the proportions of urea. Moritz Troube, in fact, asserted in 1861, after a careful examination of the subject, that all muscular force was derived from the oxidation of fat and hydrocarbons, and none from the oxidation of tissue. Haidenham, in 1864, arrived at a similar conclusion; and Donders was likewise of opinion that tissue transformation would not account for all the force of the animal body.

The hypothesis of Liebig has been further shaken by the investigations of Dr. Edward Smith, who has shown that the proportions of nitrogen in the urine does not increase with exercise, although the amount of carbonic acid exhaled by the lungs does. But the most convincing proof of the fallacy of the hypothesis was furnished in 1866 by the experiments of Dr. A Fick, the Professor of Physiology at Zurich, and Dr. J. Wislicenus, the Professor of Chemistry.

On the 29th of August of that year they prepared themselves for an ascent of the Faulhorn, one of the Bernese Alps, which rises 6,417 feet above the Lake of Brientz. For seventeen hours before the journey, they took nothing in the way of solid food but cakes composed of starch, fat, and sugar; and on the following morning, at half-past five o'clock, they began the ascent, choosing the steepest of the practical paths from the little village of Iseltwald on the Lake of Brientz. At twenty minutes past one in the afternoon their journey was accomplished without fatigue, and from that hour till seven in the evening they remained at rest in the hotel at the top of the mountain. During the whole of that time (a period of thirty-one hours) they took no other food but the non-nitrogenous biscuits; but at seven o'clock they had a plentiful meal of meat, &c.

The urine was collected at three intervals, viz.:—

1st. From 6 o'clock p.m. of the 29th, to 5 a.m. of the 30th; and this they called the night urine.

2nd. From 5 a.m. of the 30th, to 1.20 p.m.; and this they called the work urine.

3rd. From 1.20 p.m. to 7 p.m.; and this they called the after-work urine.

4th. From 7 p.m on the 30th, to the morning of the 31st; and this they called the night urine.

All these were analysed for nitrogen, and the results were as follows:—

	Grains of Nitrogen Secreted by			
	Fick.		Wislicenus.	
1st. Night urine ..	106·7		103·1	
2nd. Work urine ..	51·1	88·6	48·3	85·6
3rd. After work urine	37·5		37·3	
4th. Night urine ..	74·3		82·5	

So that not only were they able to perform the work without a nitrogenous diet, but the quantity of nitrogen excreted was less during the work than before or after. Even calculated at the hourly rate of excretion, it stands thus:—

	Grains of Nitrogen Hourly Excreted.	
	Fick.	Wislicenus.
During 1st night	**9·72**	**9·41**
During time of work	**6·33**	**6·02**
During rest after work	**6·17**	**6·17**
During 2nd night after work	**6·94**	**7·87**

The work which they had performed was estimated thus:—Fick weighed 145·5 lbs. avoirdupois, and Wislicenus 167·5 lbs.; and as they had ascended 6,417·5 feet, it is clear that Fick had raised 933,746 lbs. one foot high (145·5 × 6,417·5), and Wislicenus 1,074,931 lbs. (167·5 × 6,417·5); so that for an expenditure of muscular tissue, represented in the one case by 88·6 grains of nitrogen, and in the other by 85·6 grains, the foregoing amounts of work had been done. Now, as 1 of nitrogen represents 6·4 of dry muscular tissue, it is evident that Fick had consumed 567 grains of muscle, and Wislicenus 547·8 grains.

At the time of the experiment, the thermotic and mechanical powers of these proportions of flesh were not accurately known, but they have been since determined in a very careful manner by Dr. Frankland, who finds that when pure dry lean of beef, albumen, and urea are completely oxidised in a proper apparatus, they develope the following amounts of heat and mechanical force:—

	Lbs. of water raised 1° F.	Lbs. lifted 1 ft. high.
10 grains of pure dry beef..	13·1	10,083
" " " albumen	12·8	9,878
" " " urea ..	0·6	436

In considering the mechanical power of muscular tissue, it must be remembered that it is never completely oxidised in the animal body, but it is changed into carbonic acid, water, and about one-third of its weight of urea, so that the potential energy of muscle is not so great as in the preceding results. Calculated, indeed, according to the proportions of urea formed, the tissues of Fick and Wislicenus were capable of the following amounts of physiological energy:—

	Fick.	Wislicenus.
Quantity of muscle consumed	567·0 grs.	547·8 grs.
Actual energy if fully burnt	571,706 ft.-lbs.	552,347 ft.-lbs.
Available energy, deducting the urea..	563,466 ft.-lbs.	544,386 ft.-lbs.
Work actually done ..	933,746 ft.-lbs.	1,074,931 ft.-lbs.

So that, in the case of Fick, 370,280 ft.-lbs. of work, and in the other 530,545 ft.-lbs. are unaccounted for. But this is not all, for besides the mere labour of ascending the mountain, there were the movements of respiration, and the beating of the heart, and other motor actions, to be added to the work actually done.

Now each beat of the heart is estimated as equal to a lift of 4·6 lbs. one foot high; and it is considered from Dondor's well-known investigations that the work of an inspiration is nearly the same—viz., 4·54 lbs. a foot high. Fick says that during the ascent his pulse beat at the average rate of 120 a minute, and his respirations were 25. The beating of his heart, therefore, during the five and a half hours actually taken in the ascent was equal to 182,556 lbs. lifted a foot high; and the respiration to 37,455 lbs. If the internal labour, or, as it may be called, the *opus vitale* of Wislicenus was in proportion to his bodily weight, as compared with Fick's—that is as 7 to 6, then the ascertainable work done, was to the power of the muscle consumed, as follows:—

	Fick. Ft.-lbs.	Wislicenus. Ft.-lbs.
Work of ascending the mountain	933,746	1,074,931
Work of circulation	182,556	212,982
Work of respiration	37,455	43,698
Total ascertainable work.. ..	1,153,757	1,331,611
Actual energy of the consumed muscle	563,466	544,386
Energy unaccounted for	590,291	787,225

From which it appears that, taking only the three factors of ascertainable work—viz., external labour, circulation, and respiration—and disregarding other unascertainable motor actions of the body, which are estimated by many as greater than all the rest, the work actually performed exceeds the energy of the oxidised muscle by more than as much again.

It may be said, and truly, that these experiments of Fick and Wislicenus were of too short a duration to afford an opportunity of ascertaining whether the oxidised muscle was not afterwards excreted; but the recent researches of Dr. Parkes on the elimination of nitrogen by two healthy men (soldiers) in the prime of life, during a period of seventeen days, and under different conditions of diet and exercise, have shown that, although the results are not altogether accordant with those of Fick and Wislicenus, yet the conclusions are certainly borne out, that a non-nitrogenous diet will sustain the body during exercise for a short time, and that exercise produces no notable increase in the nitrogen of the urine. On the contrary, the amount of urea is actually less during work than at a period of rest; and he thinks that the muscle, instead of oxidising, and therefore losing its substance during labour, actually appropriates nitrogen and grows—its exhaustion being dependent, not so much on its decay as on the accumulation of the oxidised products of hydrocarbon, as lactic acid, &c., in its tissue, which require rest and time for their removal. That some decay of the muscle takes place there can be no doubt; for, as Dr. Parkes observes, "although it is certain that very severe exercise can be performed on non-nitrogenous diet for a short time, yet it does not follow that nitrogen is unnecessary. The largest experience shows, not only that nitrogen must be supplied if work is to be done, but that the amount must augment with the work. For a short period the well-fed body possesses sufficient nitrogen to permit muscular exertion to go on for some time without a fresh supply; but the destruction of nitrogenous tissues in these two men is shown by the way in which, when nitrogen was again supplied, a large amount was retained in the body to compensate for previous deprivation." It would seem, too, from the great exhaustion of the men on the second day of a non-nitrogenous diet, that their muscles and nerves were becoming structurally impaired, and that if the experiments had been continued for a third day there would have been a large diminution in the amount of work. The work which they actually performed on a non-nitrogenous diet of starch and butter, in the form of biscuits and arrowroot, was walking exercise of 23·76 miles the first day, and 32·78 the second. The first day's work occupied, with intervals of rest, about ten hours and three-quarters, and it was done without fatigue; but the second day's work took twelve hours, and the last thirteen miles were accomplished with great fatigue. Calculated according to Haughton's formula (that walking upon a level surface is equal to lifting 1-20th of the weight of the body through the distance walked), the labour in the two days was, for—

	S. Weighing with clothes 162·4 lbs.	T. Weighing with clothes 124·2 lbs.
The first day	1,018,676 ft.-lbs.	779,062 ft.-lbs.
The second day ..	1,405,397 ,,	1,074,817 ,,
Total work ..	2,424,073 ,,	1,853,879 ,,
Total nitrogen excreted	529·16 grains.	492·46 grains.
Equal to muscle oxidised	3,386·92 ,,	3,151·74 ,,
The energy of which (minus urea) is	3,267,361 ft.-lbs.	3,040,483 ft.-lbs.

The amount of nitrogen excreted during the time of actual exercise was only about half the above; and, calculated in this way, it would only account for about two-thirds of the labour-force. The results therefore prove that although the basis for the calculations of Fick and Wislicenus was too narrow for accurate deductions, yet the mechanical force of the oxidised muscle is not sufficient to account for external and internal work; and the conclusion is that, in the above experiments, the motive power of the muscles was not derived from their own oxidation of non-nitrogenous matters.

The researches of Dr. Edward Smith throw additional light on the subject, for he ascertained that the amount of carbonic acid exhaled by the lungs was in proportion to the actual work performed.

During sleep it was at the rate of..	293	grs. per hour.
When lying down and approaching sleep	355	,, ,,
In a sitting posture	491	,, ,,
When walking two miles an hour..	1,088	,, ,,
When walking three miles an hour	1,552	,, ,,
And when working at the treadmill	2,926	,, ,,

It is highly probable, therefore, that the largest amount of muscular force is derived from the hydrocarbons of our food; not that the nitrogenous matters of it may not also be a source of power; but there is no necessity, as Liebig supposes, for their being previously constructed into tissue. The experiments of Mr. Savory, in fact, show that rats can live and be in health for weeks on a purely nitrogenous diet, and it is nearly certain that under these circumstances the nitrogenous matters are mostly oxidised without entering into the composition of tissue. This, as I have said, is the main point of divergence from the hypothesis of Liebig; and it is further indicated by the fact that the amount of nitrogen excreted is not in proportion to the work done, but to the quantity of it in the food, even when there is no muscular exertion.

That the chief functions of nitrogenous matters is to repair tissue there can be no doubt, for animals kept on a purely carbonaceous diet quickly lose weight, and at last die from a disintegration of tissue; but it is equally certain that the nitrogenous constituents of food have other offices to perform. A daily diet of 2 lbs. of bread contains enough nitrogen to supply the mechanical wants of the system, but it will not maintain life. There is required an addition of animal food to render it sufficient for this purpose; and indeed the instincts and habits of the human race show, beyond all question, that a comparatively rich nitrogenous diet is necessary for the proper sustenance of life; and it is very probable that it assists the assimilation of the hydrocarbons. In this way it may help in the development of force without itself contributing directly to it; and this may serve to explain the fact, that there is a relation between the amount of nitrogen contained in the food and the labour value of it. Carnivorous animals are not only stronger and more capable of prolonged exertion than herbivorous, but they are also fiercer in their disposition, as if force were superabundant. The bears of India and America, says Playfair, which feed on acorns, are mild and tractable, while those of the polar regions, which consume flesh, are savage and untamable; and taking instances of people—the Peruvians whom Pizarro found in the country at its conquest, were mild and inoffensive in their habits, and they subsisted chiefly on vegetable food; whilst their brethren in Mexico, when found by Cortes, were a warlike and fierce race, and they fed for the most part on animal diet. The miners of Chili, who work like horses, also feed like them, for Darwin tells us that their common food consists of bread, beans, and roasted grain. The Hindoo navvies also who were employed in making the tunnel of the Bhore Ghat Railway, and who had very laborious work to perform, found it impossible to sustain their health on a vegetable diet, and being left at liberty by their caste to eat as they pleased, they took the common food of the English navigators, and were then able to work as vigorously. Abundant examples of this description—some of which will be further discussed as we proceed, may be cited in proof of the direct relation of plastic food to mechanical work; but there is no proof that this material must first form tissue before its dynamical power can be elicited.

It is, however, a remarkable fact that all forms of nitrogenous food have not the same nutritive value; the glutinous matters of barley and wheat, though almost identical in chemical composition, have very different sustaining powers. It is the same with muscular flesh and artificially prepared fibrin and gelatine. Magendie found that dogs fed solely for 120 days on raw meat from sheep's heads preserved their health and vigour during the whole of the time; but more than three times the amount of isolated fibrin, with the addition of much gelatine and albumen, were insufficient to preserve life.

We may conclude, therefore, that although the main functions of nitrogenous matters are to construct and repair tissue, yet they have manifestly other duties to perform of an assimilative, a respiratory, and force-producing quality which are far from being understood. What do we know, indeed, of the actual *modus operandi* of the nitrogenous ferments—ptyalin, pepsin, pancreatin, &c., which are secreted so abundantly in the alimentary canal; or of the conjugate nitrogenous compounds which are present in the bile? and how far have we advanced in interpreting the functions of the nitrogenous constituents of tea, coffee, maté, guarana, cocoa, &c., which the instincts of mankind in every part of the globe have evidently chosen for some physiological purpose? The same may be said of the crystalline nitrogenous matters of soup—as creatin, creatinin, inosic acid, &c., which can hardly be regarded as foods, although they have powerful sustaining properties. But enough of this for the present; and before leaving this part of the subject, I would direct attention to the fact, that nitrogenous matters when oxidised in the animal body never yield up the whole of their potential energy, for, by being converted into urea, which is the chief product of their decay, there is at least a seventh part of their power lost in the secretion. It may be that this is a necessity arising out of the circumstance that if they were completely oxidised in the animal body and converted into carbonic acid, water, and nitrogen, the last-named gas would be unable to quit the system, because of its insolubility in the animal fluids.

(To be continued.)

LABORATORY NOTES.

ALLOY OF TUNGSTEN AND IRON.

Sir,—If you think there is any novelty in the following Laboratory Note, I will thank you to give it insertion in the Chemical News:—

At a foundry in this city (Dublin) it was lately observed that some masses of pig-iron thrown into the furnace could not be brought to a sufficiently liquid state for casting; and some small fragments of one of these lumps were brought to my laboratory by a friend, for the purpose of ascertaining the cause of their difficult fusibility. They had a metallic lustre, a colour similar to that of grey pig-iron, were brittle, very hard, and possessed in several parts a vesicular structure. Their specific gravity was as high as 10·125: they were attracted by the magnet, but in a considerably less degree than pig-iron.

In muriatic acid they were partially dissolved with evolution of hydrogen. The solution, however, was incomplete, and there remained undissolved better than half the weight of the metal subjected to the action of the acid.

A second portion of this metallic material from the foundry was acted upon by aqua regia, when a yellow insoluble substance made its appearance, which was found to be tungstic acid, as it exhibited the following properties:—

It was insoluble in water or acids, and after ignition acquired a straw-yellow colour; but when placed upon a filter and washed with water, it became white and then gradually passed through the filter. In water of ammonia it readily dissolved, and the solution, when placed in contact with zinc and supersaturated by muriatic acid, gave a white gelatinous precipitate, which rapidly acquired a blue colour.

A drop of the ammoniacal solution dried on a platinum wire, and fused in the reducing flame of a blowpipe with salt of phosphorus, gave a blue bead, and then, when heated in same flame with a minute particle of green vitriol, became blood-red.

From these experiments it appeared that the heavy metal from the foundry was an alloy including a considerable quantity of tungsten.

A number of experiments were now made for the purpose of determining its exact composition, and the following final results were obtained:—

Tungsten	38·23
Iron	61·77
	100·00

Numbers which correspond pretty accurately with the formula $Fe_{11}W_2$. Of the 61·77 grains of iron, 41·46 are taken up by hydrochloric acid. The residue, amounting to 20·31 grains, had to be removed by fluxing the undissolved portion of the alloy with a mixture of nitre, carbonate of soda, and common salt, by which the iron was oxidised and the tungsten converted into tungstic acid.—I am, &c.,

J. A.

Dublin,
October 3, 1868.

CORRESPONDENCE.

WANKLYN & CHAPMAN'S "WATER ANALYSIS."

To the Editor of the Chemical News.

Sir,—You will allow me in justice to myself and to Messrs. Wanklyn and Chapman, who have brought my name forward in support of some of their statements connected with the "Ammonia Process," to point out exactly in what my testimony consists.

The Chemical News of November 29, 1867, contains a letter of mine, wherein I drew attention to the advisability of representing in degrees of "organic nitrogen" the ammonia evolved from natural waters when submitted to the successive action of sodic carbonate and potassic permanganate. As illustrations of my scheme, I gave analyses of three waters made by the "Ammonia Process."

At the close of the letter I said—

"Water No. 1 confirms Professor Wanklyn's statement in the *Laboratory* (No. 26, page 442), with reference to the stability of albumenoid matter in the presence of a boiling solution of sodic carbonate of the strength used by himself and colleagues in their process."

The water in question did not give any ammonia when a litre was distilled with carefully purified sodic carbonate, though it yielded an appreciable quantity after the addition of the permanganate. This experiment shows that some waters, although they do not give ammonia by distillation with sodic carbonate, yet contain a nitrogenous substance of greater or less complexity, capable of being totally or in part converted into ammonia by potassic permanganate. This substance, whatever it may be, has been called albumenoid matter, for want I take it of a more exact definition.

So far, then, as regards natural waters, my experience accords with that of the authors' in the one particular I have mentioned. To turn to another part of the subject, viz., the stability of albumen proper (white of egg) when distilled with sodic carbonate, test experiments gave me anomalous results, equal weights of different samples yielding unequal weights of ammonia. An observation led me to infer that white of egg contains, perhaps, traces of some ammonia salt or derivative variable in amount in different specimens, and that it is to the presence of such salt that the traces of ammonia found in the distillate are to be ascribed. Again, the small quantity of ammonia evolved by the soda treatment from large quantities of albumen, taken in conjunction with the fact that after a while the evolution ceases, point rather to the same conclusion.

As an impartial observer I consider the choice of the words "Albumenoid Matter," by the authors unfortunate; had they hit upon some other term, they would in all probability have been spared the refutation of much of that criticism, based on the assumption that albumen and albumenoid matter are necessarily synonymous expressions.—I am, &c.,

Philip Holland.

Chorley, October 3, 1868.

A QUESTION IN THERMOTICS.

To the Editor of the Chemical News.

Sir,—Would you oblige me by explaining the following point?—

The total quantity of heat required to convert 1 gramme of water at 0° C. into steam at 100° C. is

$$(100{\cdot}5 + 536{\cdot}5) = 637 \text{ heat units};$$

according to Regnault's formula,

$$C = {\cdot}305.t + 606{\cdot}5,$$

the quantity is

$$30{\cdot}5 + 606{\cdot}5 = 637.$$

But the quantity of heat, latent and sensible, in 1 gramme of steam at 100° C. is less than 637 units; for since the specific heat of steam is ·4805, the quantity of sensible heat in 1 gramme of it at 100° C. is

$${\cdot}4805 \times 100 = 48{\cdot}05;$$

and the quantity of latent heat in it is 536·5.

Hence the total quantity of heat in 1 gramme of steam at 100° C. is

$$48{\cdot}05 + 536{\cdot}5 = 584{\cdot}55.$$

Consequently it appears to me that, while 637 heat units have to be added to 1 gramme of water at 0° in order to convert it into steam at 103°, only 584·55 heat units have to be removed from the steam to get it into water at 0°.—I am, &c.

Volta.

MISCELLANEOUS.

To Detect the Presence of Atmospheric Air in Coal Gas.—Dr. T. Werner, at Breslau, recommends for this purpose the use of the following substances:—Ten parts by weight of anhydrous sulphate of protoxide of manganese are put into a two-necked Woulf bottle, and then therein dissolved in twenty parts of warm water. To this mixture is immediately added a solution of ten parts by weight of tartrate of potassa and soda (Rochelle salt), dissolved in sixty parts of water; the thorough mixing of the fluids is promoted by well shaking of the bottle, after this there is added a quantity of a solution of caustic potash sufficient to render the fluid quite clear; immediately after this the corks, perforated of course and fitted with very tightly fitting glass tubes, are placed in the necks of the bottle, which should be entirely filled with the mixed fluid just alluded to. One of the glass tubes—the inlet tube for the gas to be tested—should just dip a little under the upper level of the fluid; the outlet tube, on the other hand, should only reach half way the perforation of the cork. A very slow current of gas is now made to pass through the fluid, and kept going for at least quarter and at most one full hour. In case the gas is quite free from atmospheric air, the fluid in the bottle will remain quite clear; if traces even of air are present, a faint colouration of the liquid will soon become apparent; with a larger proportion of air present in the gas the fluid will soon be rendered first light brown coloured, and afterwards intensely black. Since these changes of colour are due to the oxidation of the salt of manganese, it is evident that every care must be taken to avoid the presence or access of accidental air; the fluid in the Woulf bottle should reach the cork. It is best to cool the bottle during the experiment with ice, if at hand, otherwise with very cold water; the current of gas must be slow.—*Pharmaceutische Zeitschrift für Russland*, 1868, No. 7.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Comptes Rendus.

July 6, 1868.

De la Rive, "On the cause of the Intensity of the Magnetic Rotatory Power of Thallic Alcohol." J. Jamin, "On a Thermo-rheometer." Leaute and Denoyel, "On a Lamp for Submarine Operations, fed by Oxygen, without Communication from the External Atmosphere." G. Lechartier, "A Reproduction of Pyroxenes and Peridots." Rosenstiehl, "On a new Alkaloid, Isomeric with Toluidine, contained in Commercial Aniline." Schutzenberger, "Researches on the Action of Hypochlorous Acid Gas on a Mixture of Iodine and Acetic Anhydride." (Continuation.) C. Husson, "On the Action of Iodine on Arseniuretted and Antimoniuretted Hydrogen.

July 13, 1868.

C. Friedel, "On Iodide of Silicium and on Siliciiodoform."

Bulletin de l'Académie Royale de Belgique. (Classes des Sciences.)

June 6, 1868.

L. de Koninck and Stas, "Report on L. Henry's Researches on the Sulphocyanides of Organic Radicles." L. Henry, "Researches on the Sulphocyanides of Organic Radicles: Action of the Hydracids of the Halogens on the Sulphocyanides of Monatomic Alcohol-radicles.

Annalen der Chemie und Pharmacie.

July, 1868.

R. Fittig and J. Storer, "Researches on Mesitylene. (Second Memoir.) On some new Substitution Products of Mesitylene." R. Fittig, "On Pseudocumol and some of its Derivatives." R. Fittig, W. Ahrens, and L. Mattheides, "On the Xylol of Coal Tar, and on the Synthesis of Methyl-toluol (Dimethyl-benzol). R. Fittig, "Note on the Brominated Substitution Products of Toluol." R. Fittig and W. H. Brueckner, "Researches on Mesitylene. (Third Memoir.) On the Derivatives of Mesitylenic Acid." L. Glutz, "On Oxysulphobenzide and some of its Derivatives." F. Gauhe, "On Diamidobenzol." H. Kolbe and F. Gauhe, "On Nitro-oxyphenylsulphuric Acid and Dichloroxyphenylsulphuric Acid." K. Kraut, "On Cinnamic Acid and its Isomer Atropic Acid. (First Memoir.)" A. Claus, "On the Decomposition of Grape Sugar in Alkaline Solutions by Oxide of Copper: Formation of Oxymalonic Acid (Tartronic Acid)." L. Carius, "On Propylphycite, and on Claus's Experiments with the same."

Annales de Chimie et de Physique.

July, 1868.

L. Cailletet, "On the Influence of Coloured Light on the Decomposition of Carbonic Acid by Plants." E. Filhol, "On Chlorophyll." J. Kolb, "Researches on Bleaching Fabrics."

Kunst- und Gewerbeblatt.

April, 1868.

N. Stanoe and A. Spakowsky, "An Improved Apparatus for Burning Petroleum and other Fluid Hydrocarbons in the Form of Spray. C. Stolzel, "A Method of Coating Iron and Steel with Copper."

May, 1868.

S. Merz, "Researches on the Optical Properties of Flint Glass. Böttger, "On a Fluid for Coating Copper, Brass, and German Silver &c., with Platinum. On a Method of Preparing Zinc to receive a Coat of Paint."

Journal des Fabricants de Papier.

May 15, 1868.

"On the Manufacture of Filter Paper."

July 20, 1868.

Sidot, "Researches on the Magnetic Polarity of Artificially-prepared Iron Pyrites, and of the Corresponding Oxide." P. Schutzenberger. "On the Colouring Matters of Persian Berries."

Monatsbericht der Königlich Preussischen Akademie der Wissenschaften zu Berlin.
April, 1868.

G. Vom Rath, "On a new Crystalline Modification of Silicic Acid." Rammelsberg, "On the Constitution of the Periodates." A. W. Hofmann, "On Menaphthylamine."

Poggendorff's *Annalen der Physik.*
June 9, 1868.

T. Petersen, "Analyses of Minerals from Wittichen, Baden." H. Vogel, "A new Photometer for Determining the Chemical Action of Light."

Bulletin de la Société Chimique de Paris.
July, 1868.

Berthelot, "Note on an Error in the Author and Jungfleisch's Researches on Perchlorinated Benzine, Perchlorinated Naphthaline, and Julin's Chloride of Carbon." E. Bourgoin, "On the Electrolysis of Oxalic Acid." J. Joffre, "An Analysis of some Bituminous Schists from Scotland." P. Audouin, "A Process for Extracting Ammonia from Gas Liquor."

Journal für Praktische Chemie.
No. 12. 1868.

J. L. W. Thudicum, "Chemical Researches on the Colouring Matters of Bile." E. Calberla, "Contributions to the Elementary Analysis of Nitrogenous Substances."

July, 1868.

H. Salkowski, "On some new Arsenates, and on a new Method of Estimating Bismuth." H. Zschiesche, "On the Atomic Weight of Lanthanum." G. Werther, "Remarks on the Isomorphism of Potassium, Thallium, Cæsium, and Rubidium." R. Hermann, "On Granatine and Achtaragdite, two new Minerals from Siberia." G. Leuchs, "On the Presence of Iodine and Soluble Salts in the Dust of the Gases evolved from Blast Furnaces." E. Richters, "Researches on the Causes of the Refractory Qualities of Clay."

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2418. J. Heaton, Langley Mills, Derbyshire, "Improvements in the production of steel and other compounds of iron and carbon resembling steel.—Petition recorded July 31, 1868.

2725. J. H. Johnson, Lincoln's Inn Fields, "Improvements in the preparation of a blue colour from aniline."—A communication from P. P. Zweifel, Paris.—September 4, 1868.

NOTICES TO PROCEED.

1432. J. Heaton, Langley Mills, Derbyshire, "Improvements in reverberatory and other furnaces.—Petition recorded May 2, 1868.

1470. D. R. Macgregor, and P. Taysen, Leith, Edinburgh, "Improvements in the manufacture of paint for the protection of iron and other metals from the destructive influence of sea water, and for the prevention of fouling."—A communication from H. W. Matzen, Sonderborg, Schleswig.—May 5, 1868.

R. Moore, Glasgow, N.B., "Improvements in the manufacture or treatment of crushed sugar."—A communication from C. Spreckles, San Francisco, California.—May 11, 1868.

1579. J. E. Piper, Wilson Street, Finsbury, Middlesex, "A new or improved oil for lubricating machinery."—May 14, 1868.

1602. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved mode of embalming or preserving dead bodies."—A communication from C. A. Seeley, C. '. Eames, W. R. C. Clark, and M. L. Booth, New York, U.S.A.—May 15, 1868.

1617. W. E. Gedge, Wellington Street, Strand, Middlesex, "An improved process for extracting or removing wool and hair from hides or skins."—A communication from P. Clérin, Faubourg St. Martin, Paris.—May 16, 1868.

1980. C. Hengst and H. Watson, Fulham, Middlesex, "An improved mode of, and means for, manufacturing gas for lighting and heating purposes.—June 18, 1868.

NOTES AND QUERIES.

Fireproof Dresses.—In answer to Mr. Philip Sankey's inquiry in your number of September 11th, he may receive full particulars of a satisfactory process on writing to, or calling on, J. Versmann, 26, Alfred Street, Bow, London, E.

Adulterated Honey.—According to a short notice in No. 34 of the *Deutsche Industrie Zeitung*, there are at present in Germany itinerant dealers in so-called Swiss land-honey. This substance finds a large number of purchasers, on account of its fine taste and beautiful appearance, while, instead of being real honey, it is simply starch converted into sugar by means of sulphuric acid. It may be detected by means of the presence of sulphuric acid therein—viz., in the shape of sulphate of lime or gypsum; its use, of course, is perfectly harmless, but it is not honey, nor does it contain any at all.—Chemicus.

Bleaching and Dyeing Cotton.—On referring to several works on bleaching and dyeing cotton, I do not find any suitable—*i.e.*, on the large scale—practicable method recorded for bleaching cotton in the cop; it has been tried, but with no good result. As to the "fast" green dye, excepting the Chinese green, lo-kao, and chrome green, all green dyes are compounded from blue and yellow. It would take far too much space to enter into detailed accounts of the various receipts for these dyes, but your correspondent may be referred to the following works:—"A Dictionary of Calico Printing and Dyeing," by Charles O'Neill. London and Manchester: Simpkin and Marshall, and A. Ireland. 1862.—Johannes Rudolf Wagner, "Hand und Lehrbuch der Technologie." 5 vols. Leipzig, 1862. (Vol. 4 contains the required information)—"On Lo-kao, or Chinese Green," several small pamphlets have been published—viz., by Roudot and Persoz, Paris, 1858; Lößer, Das China grün Weimar, 1861.—"A Practical Treatise on Dyeing and Calico Printing." New York: Harper, Brothers, 1859.—Lastly, I may quote the yet sound and highly classical work on this subject by J. Persoz, "Traité Théorique et Pratique de l'Impression des Tissus." Paris: Victor Masson, 184; 64 vols., and large quarto atlas with plates. Perhaps there is a second and more recent edition.—A.

Technological Analysis of Water.—The soap-test, though it shows the value of waters for domestic and for certain manufacturing purposes, throws very little light upon their adaptability to the purposes of dyer and printer. Two samples of water of the same degree of hardness may have very different actions upon colouring matters, according as the hardness of the one depends upon lime, and that of the other upon a salt of alumina or of iron. Having been obliged to make very numerous and rapid examinations of river waters contaminated with manufacturing refuse, I have found great advantage in employing an extract of logwood—a reagent readily and distinctly affected by the various impurities likely to be present. I prepare the extract as follows:—Distilled water is digested upon an excess of rasped logwood in a stoppered vessel for twenty-four hours, when the clear liquid is decanted off for use. 4 ozs. of distilled water are then put in a phial of clear white glass, and 100 gr. measures of the logwood extract added. This dilute liquor is of a clear reddish amber colour, and serves as a standard for comparison. 4 ozs. of the sample of water in question are then poured into a phial exactly similar to the above, and the same quantity of logwood extract is added. If the water contain a soluble chloride, the colour given will be yellower than in the case of distilled water. Gypsum, or an alkaline sulphate, will produce a yellow, bordering on olive; alkalies, hydrated or carbonated, will give a brownish red; salts of alumina, a maroon passing into plum-colour; free acids, a cherry; and salts of iron and chromates a black-brown. Even the quantities of these impurities may be approximately determined by preparing solutions containing known quantities of the various salts above-mentioned, and comparing their action upon the logwood extract with that of the sample in question. Waters holding solid matter in suspension must, of course, be previously purified by subsidence and filtration.—W.

TO CORRESPONDENTS.

J. A. Wanklyn—E. T. Chapman.—Surely these pertinacious gentlemen must see the absurdity of expecting an Editor to insert a series of letters in reply to a review. We must of course decline to print a second, and we do so with the less regret because we do not perceive that the letter in question adds anything to the real history of the case. In coming to this decision, we have been influenced neither by the insulting remarks in the letter which accompanied the communication, nor by apprehension of the dreadful consequences which are to follow this refusal. The answers which our correspondents make to our strictures appear to us to be nothing but verbal quibbles, and are entirely unsatisfactory.

A. H. Smith.—No good would be gained by publishing your remarks on the process. If you read the review you will see that our opinions are about as favourable as your own.

Fair Play.—Read the review again and you will see that it is a remarkably favourable one. Then read the book and you will be able to judge how lenient we have been to its many faults.

Carbon.—To answer your question would fill a number. The records of the patent office will supply you with almost any number of apparatus for the manufacture. There is a good demand for bisulphide of carbon, but the price is so low as to be barely remunerative unless other manufactures are united with it.

E. K.—The most philosophical work which has yet appeared on the subject is Professor Wurtz's "Introduction to Chemical Philosophy," published at our office.

A Novice.—Sulphate of silver may be made by mixing together hot strong solutions of sulphate of soda and nitrate of silver. The sulphate of silver precipitates in brilliantly white crystals. Another way to prepare sulphate of silver is to dissolve silver in hot sulphuric acid. The resulting salt must be purified by washing and crystallisation.

Communications have been received from Messrs. Wanklyn and Chapman; Dr. Apjohn; Dugald Campbell; P. Holland (with enclosure); W. J. Bush (with enclosure); W. Little (with enclosure); T. N. Hutchinson; A. H. Smith; P. LeNeve Foster; M. G. Meinhard; W. B. Giles; A. W. Wilson; W. W. Roberts; D. Forbes, F.R.S.; J. Spiller; Dr. R. Angus Smith, F.R.S.; G. F. Rodwell; D. Faulkner; Dr. Wood (with enclosure); R. Richter; A. Vacher (with enclosure); H. D. Turner; T. Watts; C. Becker; Dr. Bingley (with enclosure); J. C. Wilson; Mottershead and Co. (with enclosure); and J. Hulle (with enclosure).

Errata.—In Mr. Holland's letter in our last number. The words *holders* and *bars* (lines 9 and 32) should be singular instead of plural.

THE CHEMICAL NEWS.

Vol. XVIII. No. 463.

ON THE COLOURED REACTIONS OF ANILINE, TOLUIDINE, AND PSEUDO-TOLUIDINE.

By M. ROSENSTIEHL.

The alkaloids used in the examination of these reactions were prepared with salts whose purity had been proved by the constancy—first, of the reactions, and secondly, of the solubilities, after fresh crystallisations. Since the first introduction of aniline into commerce, a large number of highly sensitive reactions have been made known, which were believed to be characteristic of this base; but the fact of the presence of pseudo-toluidine in this commercial product throws some doubt upon the worth of this means of analysis. By subjecting these reactions to a vigorous revision, I have discovered that there exists only one really characteristic of aniline—viz., that discovered by Runge; this has been accused of being very variable, but a slight modification will not only render it much more certain, but also greatly increase its sensibility. If a few drops of a solution of chloride of lime be added to aniline suspended in water, the intense blue colour first developed will quickly change to brown. In the presence of homologous alkaloids, the blue colour becomes gradually less apparent, disappearing before the brown products yielded by the toluidine; if, however, a little ether be added, and the mixture carefully stirred, all the brown matter will be retained by that solvent, and the water will assume a pure blue colour. Should the discovery of traces of aniline in a mixture (toluidine, for instance) be desired by this process, about 1 gramme of the alkaloid must be dissolved in 10 cubic centimetres of ether, an equal volume of water must then be added, and into this mixture a solution of chloride of lime, 1·055 in density, is gradually dropped, carefully stirring after each addition. When only very small quantities of aniline are present the water gradually assumes a blue tint; and it is important to exhaust the action of the chloride of lime without introducing an excess of the reagent. According to experiments made in conjunction with M. Clemm, it appears that 5 cubic centimetres of chloride of lime, 1·055 in density, are requisite for 1 gramme of alkaloid. The quantity of aniline contained in a mixture may be ascertained up to a certain point by working comparatively with a standard. By this approximative method, I discovered the presence of 2 per cent of aniline in M. Coupier's toluidine. In the above experiment pseudo-toluidine may be substituted for aniline, in which case the water turns yellow, while the ether is simultaneously charged with a slightly coloured base, whose salts are of a fine violet red. If this etherised film be decanted and stirred in slightly acidulated water the liquid will assume a tint comparable in beauty and intensity to that of a permanganate solution. This reaction is very sensitive, allows pseudo-toluidine to be discovered in the presence of the other two alkaloids, and would be still more clearly perceptible if the quantity of the former mingled with these latter were not so small. The reactions given by toluidine with chloride of lime are negative only.

Most of the other reactions proposed for aniline rest upon its transformation, by means of sundry oxidising agents, into Perkin's purple, which is well known to be transmutable by the aid of acids into blue, green, and even yellow; these colours may be considered as corresponding with polyacid salts of mauveine. The blue colour being much the most intense, it is that which we should endeavour to induce, if the discovery of small quantities of colouring matter be desired; the above colour may be instantly obtained by means of dihydrated sulphuric acid, in which medium it is very stable, provided the concentration of the acid remain unchanged.

All bodies which liberate chlorine or oxygen in the presence of sulphuric acid yield highly intense blue shades in connection with aniline and pseudo-toluidine; such are the chromates, oxygenated compounds of chlorine and manganese, binoxide of lead, chlorine, oxygen evolved at the positive pole of the pile, and an admixture of nitric and chlorhydric acids. Toluidine yields no colour with either of these reagents. Until now no means were known of discovering this base; but if the reagent be changed, and nitric acid employed as an oxidising body, the actions are exactly reversed. When working in the cold, aniline and pseudo-toluidine give no colour, while toluidine yields a pure intense blue. This reaction is very delicate, and requires exactly the conditions described; dissolve the toluidine in dihydrated sulphuric acid, let it cool, pour several cubic centimetres of this solution into a thoroughly dry tube, and add a drop of nitric acid; the colour is produced in a second, lasts about a minute, and then changes to violet and red. This reaction offers the double advantage of allowing the discovery of small qnantities of nitrates in the presence of chlorides and chlorates, and also of recognising small quantities of toluidine in a mixture, as, for instance, in commercial aniline; but then the colour produced is no longer blue, but varies from blood-red to blue-violet, passing through all the intermediate shades according to the proportion of toluidine; it is therefore important, in order to avoid error, to employ products exempt from chlorine. It is really surprising how little chlorine will suffice to turn aniline blue in the presence of nitric acid, and the colour, at first feeble, augments in intensity. This remarkable fact is easily understood, on reflecting that in the presence of nitric and sulphuric acids, of the concentration indicated, the chlorine must necessarily be indefinitely regenerated, and that by the same rule its action must be multiplied an hundred-fold.

The fact which I have described shows how delicate are the reactions, in consequence of their extreme sensibility, and that in order to avoid errors in observation, it is necessary to employ pure reagents.—*Comptes Rendus.*

DETECTION OF NITRATES IN WATERS.

By THOMAS P. BLUNT.

The following test for the presence of nitrates in a drinking water is a little more delicate than the common one with ferrous sulphate; it depends on the reducing action exercised by sodium amalgam on nitric acid.

It was found that when a moderately concentrated solution of nitrate of potassium was poured over an amalgam of sodium containing about ½ per cent of the metal, there was no evolution of hydrogen, and on pouring off the supernatant fluid after some minutes, and applying the Nessler test, a considerable quantity of ammonia was detected. A solution of pure nitrate of potassium, containing 1 part in 1000, was then prepared, and measured quantities were added to different portions of ½ per cent sodium-amalgam, consisting of about 200 grains each; it was thus found that 20 grain measures of nitrate solution, representing 1-50th grain of the salt, gave a just perceptible colouration with the Nessler test after standing over the amalgam for about twelve hours; 40 grain measures (= 1-25th grain salt) gave a marked reaction. Several attempts have been made to adapt the above test to the estimation of small quantities of nitric acid; they have at present, however, been unsuccessful, through the impossibility of pushing the reaction to completion; it is possible, however, that a system of comparative testing analogous to that at present adopted in the case of ammonia may lead to some results. As an example of the mode of applying the test qualitatively to a drinking water, the following account is given of an actual experiment:—

To 2 ounces of a water known to contain a trace of nitrates, was added about 100 grains of a solution of hydrate of potassium, containing 1-12th of its weight of alkali; the whole was then evaporated nearly to dryness; thus any ammonia already existing in the water would be expelled. The residue was exhausted with distilled water which gave no reaction with the Nessler test, and the quantity of the solution made up to 200 grain measures, which were afterwards divided into two equal portions. One was at once tested with ferrous sulphate solution and sulphuric acid; a very faint brown colouration appeared at the point of junction of the layers of liquid, increasing considerably after a few hours.

The second portion was introduced into a carefully cleaned test-tube, with about 200 grains of ½ per cent sodium amalgam: the tube was lightly corked to check diffusion of the ammonia formed as far as possible, but not so tightly as to prevent the egress of the hydrogen, which in dilute solutions of a nitrate is always evolved from the amalgam. The whole was left for about twelve hours: the liquid was then rinsed with successive portions of pure distilled water into a glass cylinder about 6 inches high and 1 inch wide, and the quantity was made up with distilled water to about 1000 grains. On adding about 15 grain measures of the Nessler test, a very strong colouration, accompanied by incipient precipitation at once appeared. It is to be remarked that the liquid must always be decanted from the amalgam before applying the Nessler test, as the presence of nascent hydrogen appears to interfere with the action of the latter.

Shrewsbury, Oct. 12, 1868.

ON THE REDUCTION OF OXIDE OF COPPER TO THE STATE OF METAL BY MEANS OF INVERTED SUGAR.

By M. A. COMMAILLE.

Until the present time it was believed that the reducing action of sugar on salts of copper was arrested at the protoxide (Cu_2O), and that it was impossible to obtain the metal as such, when under similar circumstances a salt of bismuth was substituted for salts of copper, in which case metallic bismuth* was precipitated. All the oxygen combined with the copper may, however, be removed by means of inverted sugar, but the metal is sometimes obtained pure, and sometimes as a mixture of copper and protoxide, according to the state of the liquid. Sometimes the copper presents the roseate appearance of galvanoplastic copper; at other times it will be much duller, but acquire brilliancy from polishing.

In order to obtain the reduced copper, take a very dilute solution of that metal and pour into it sufficient caustic potash to produce a precipitate; add to this liquid a solution of inverted sugar, and the precipitate will dissolve; the solution, which should not be acid, is then boiled; and after a short time a red deposit of protoxide is formed, which must be separated. The liquid is again boiled, and a fresh precipitate appears, which is proved to be formed of metallic copper and protoxide, which latter is removed by very weak chlorhydric acid; the undissolved precipitate is dried and polished with some hard body, when it presents the brilliant aspect of metal. On boiling the mother waters, by which the second precipitate was deposited, a third deposit is obtained, consisting only of metallic copper, and as red as galvanoplastic copper.

This metal may also be instantly obtained by the following method, without any mixture of protoxide:—

Before reducing the precipitate produced by the potash in the sulphate solution, by means of the inverted sugar, neutralise the acidity of the sugar solution, and when the precipitate of the copper hydrate is almost entirely redissolved, filter it, and boil the limpid liquid thus obtained; the metallic copper will then be seen to fall, but its colour is not quite so bright as in the former experiment.

I found it impossible, when working with M. Frommherz's liquid under ordinary circumstances, to obtain metallic copper; nevertheless it appears to me necessary to be on one's guard in saccharometry against the possibility of the complete reduction of oxide of copper.

ELECTRIC ILLUMINATION.

Sundry Experiments Relative to the Production of Electric Light.

By F. P. Le ROUX.

The brilliant phenomenon, now popularly known by the name of electric light, was first discovered by Davy; who, in 1813, conducted the current of a powerful pile between two pieces of charcoal. For more than half a century mankind has been dazzled by this light, whose brilliancy is comparable only to the sun, and yet many theoretical questions as to its intimate nature remain to be solved, and many practical difficulties with respect to its extended employment to be removed. The experiments which form the subject of this article may be found interesting from both points of view.

On the Nature of the Voltaic Arc.—In order to examine in detail, and without fatigue, what takes place between the two pieces of charcoal in Davy's experiment, the phenomenon should be projected upon a screen, that is to say, an augmented image should be produced by means of a lens, an experiment which is now common. Two salient traits of this phenomenon will now be remarked; on the one hand, the vivid incandescence of the points of charcoal, which glow with the brilliancy of the sun; on the other, the soft bluish clearness of the intervening space.

This bluish space generally presents the appearance of a conical trumpet, whose larger extremity rests upon the positive, and its lesser upon the negative point of charcoal. The slightest breath will alter the shape of this bluish light, which curves from its centre in an opposite direction to the breath, while its extremities continue to rest on the most incandescent points of the charcoal; this has led to the conclusion that it is produced by a highly rarefied substance extending between the charcoal poles.

At the time these experiments were first made it was usual to arrange the charcoal points in a horizontal line, where the ascension of currents of heated air naturally produced the incurvation above described, and led to its receiving the name of the voltaic arc; this name it still preserves, although it is no longer justified by the external appearance of the phenomenon, owing to the vertical arrangement of the charcoal now general.

The voltaic arc may be distorted or even broken by the proximity of a magnet; the sensible effect of a magnet on the arc is similar to that which it would have on a highly flexible circuit, permeated by the same current as the intervening space. It is evident that the voltaic arc is exactly the route taken by the electric current in passing from one point of charcoal to the other.

A glance at the whole phenomena will suffice to show that the quantity of light proceeding from the arc itself is minimum, and that the incandescent surface of the charcoal is the true source of the so-called electric light; but the portions of that surface, where the incandescence is incomparably more vivid than elsewhere, are the extremities of the sticks of charcoal, just at the places between which the arc extends.

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* M. Stolba obtained metallic copper by means of glucose.

What then is this arc? It is evidently composed of that constituent of the charcoal, which experience has shown to be conveyed from one point to the other. What form does then this matter take during its passage? Is the carbon merely disseminated as an excessively fine dust, or in a state of gas? This has not as yet been definitively answered, but some experiments which will presently be described, tend to cause the belief that carbon exists in the arc under the form of vapour.

One circumstance which is immediately perceived on examining the pieces of charcoal is the great difference in their temperature. The positive charcoal is considerably more luminous than the other, and its incandescence extends over a longer duration. I am even inclined to believe that the negative charcoal is heated almost entirely by the radiation of heat from the positive charcoal on one hand and the arc on the other, and by the heat proceeding from the condensation of the matter conveyed by the latter. I have made one experiment of a very simple kind, but which, however, I have never heard described, which will show that the heating of the positive pole is owing to a special cause, the seat of which is the exact point where the voltaic arc joins the charcoal. The experiment consists in this:—The charcoal electrodes are first brought into contact in the ordinary manner, and then separated so as to produce a very short arc of only a small fraction of a millimetre, which is interrupted at the end of some seconds; the positive electrode will then be found to remain incandescent for some time, whilst the extremity of the negative electrode will be scarcely red. By this mode of operation the heat evolved by the arc is almost entirely eliminated, as the latter from its shortness offers feeble resistance, and is consequently the seat of but a slight disengagement of caloric. If, on the other hand, the extremity of the positive charcoal be really the source of evolution of caloric, one would suppose that the caloric would communicate itself more rapidly by interior conduction to the mass of the positive charcoal than by radiation to the negative charcoal, and that if the passage of the current were interrupted for a few moments, a marked predominance of the first of these effects would be apparent; this, the experiment shows to be the case. There exists, then, at the positive pole, a special source of evolution of caloric hitherto unexplained, but which does not, to me, appear inexplicable; I shall, however, revert to this subject in a special publication.

Employment of a Current of Oxygen for Disposing the most Luminous Portions of the Charcoal to Greater Advantage.—It has just been remarked that the greater proportion of light arises from those portions of the surface of the electrodes, between which the arc arises; that of the positive pole is slightly concave, that of the negative more or less convex; that of the positive pole exceeds the other both in size and brilliancy. As it is usual to arrange the electrodes in the same vertical line, the illuminating surfaces in question are necessarily presented obliquely with regard to a horizontal direction, which is generally that in which the light is used. If from defective homogeneity of the charcoal, or any other cause, these surfaces should bend in any direction, the illuminating power will be seen to vary in that direction also. With such charcoal as that produced by gas retorts, the only kind now obtainable in the present state of commerce, and very impure, the disturbance of the arc is perpetual, and in photometrical measurements the illuminating power of an electric lamp is seen to vary at each moment within extensive limits. I believe that if the arc could be made to remain always inclined in a given direction—that, is towards the side on which the maximum of light is desired to be thrown—that the steadiness of the light would be secured; this was satisfactorily proved to be the case; the arc being forced to incurve, the surfaces which formed its base were so much the more vertically inclined, and the light thereby more clearly directed towards the region desired to be illuminated. It is particularly necessary that the current of gas should incline the electrodes in a different direction to that in which the arc is bent, otherwise they will approach each other too closely, and the arc, choosing the most direct road, will also change its position. It is exactly this combustion of the charcoals, which is performed by a current of gas, which turns them towards two eccentric points, between which the arc naturally maintains itself so easily that the slightest force is sufficient to incurve it as we have described. The gas pipe should be placed at about 1 centimetre from the charcoal electrodes, and slightly below a horizontal plane passed between them, in order to combat the tendency acquired by the gas as it heats to flow in greater quantity towards the upper electrode. A good result is obtained by causing the gas to escape by two holes of about 1 millimetre in diameter and 1 millimetre apart; the consumption of oxygen is not great, and may be estimated at about 15 litres per hour. It is of course understood that the conditions must vary with the size of the electrodes and the force of the electric current employed, the stream of gas being weaker and weaker in proportion to the diminution in the size of the electrodes.

I should recommend all who desire to put this experiment into practice to carefully isolate the tube containing the gaseous current, as without this precaution the arc might come in contact with it, and cause its instantaneous destruction.

Arrangement for Subjecting the Voltaic Arc to Spectral Analysis.—The image of the voltaic arc and luminous electrodes being already thrown upon a screen, let us conceive a small opening to be made in that part of the screen upon which the arc is projected, and thus an extremely simple means is obtained of isolating the light emitted by the arc from that of the electrodes. By placing the slit of a spectroscope behind this opening the character of the light emitted by gaseous substances is instantly perceived—namely, discontinuity. The spectrum of the voltaic arc is perhaps the most beautiful spectacle offered by the spectroscope; it appears to me to resemble most the spectra observed by MM. Plucker and Hittorff[*] during the combustion of cyanogen in oxygen, and also by M. Morren in that of carbon.[†]

I intend to make an exact determination of this spectrum as soon as it is possible to use a purer carbon than the charcoal of gas retorts; at present we can do no less than infer the presence of gaseous carbon in the voltaic arc. The proceeding just described may perhaps be also applicable to the examination of different portions of other kinds of flame; it will be only necessary to place a screen at the distance of about a few millimetres from the slit of the spectroscope, and to there project, by means of a lens, the image of the flame to be examined; by this means it may be ascertained at any moment what part of the flame is under the spectral analysis.

Spontaneous Re-appearance of the Voltaic Arc after an Interruption of Short Duration.—About twenty years ago, M. de la Rive, when studying the effect of magnetism on the voltaic arc, succeeded in producing it between bars of soft iron; he then observed that under certain conditions the arc was sometimes broken by the influence of an electric current circulating around these bars, but that if the disturbing influence was removed before the poles had cooled, the arc sometimes re-appeared without obliging him to bring the poles into contact.

Ten years later M. Wartmann, of Geneva, in experimenting on the practical application of electric light, proved that "it was possible to suspend the circulation of electricity between two charcoal electrodes during 1·20th of a second, without, he says, the arc disappearing."[‡]

M. Wartmann considered that, for a certain time after the interruption of the current, certain solid particles remained interpolated between the two poles. I was led to a more detailed study of these phenomena, by endeavouring to give some description of the production of electric light by means of magneto-electric machines, in which case the current changes, as is well known, many times in a minute, and must therefore of necessity pass by zero—that is, it must be interrupted.

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[*] Plucker and Hittorff, *Philosophical Transactions*, 1865.

[†] A. Morren, "On the Flame of some Carburetted Gases. (*Annales de Chimie et de Physique*, 4th series, vol. 4, 1865).

[‡] *Bibliotheque Geneve* (Archives des Sciences Physiques et Naturelles, vol. 36, page 325, 1857).

The first question to be asked is, Is the arc really interrupted at the same time as the current? Observation has proved that the arc really ceases to exist during the interruption of the current; the following is a convenient method of demonstrating it to a numerous audience.

At the end of a pendulum, beating about every half second, is suspended a screen upon which the reflection of the electrodes is thrown by means of a lens; by this contrivance the reflection of the electrodes is displaced upon the screen. Consequent upon this is the displacement of the image formed upon the retina, whose sensation is thus rendered less obtuse than it would be were the image continually in the same place, and the changes of short duration which the object under examination may undergo are more easily perceived.

These arrangements being finished, the two electrodes are placed at a distance from each other of about 2 millimetres, and there fixed (if they be mounted on a regulator the movement must be stopped), and the current is then interrupted by the hand for a period not exceeding 1-20th of a second. This interruption may be more easily made by a spring plate working against a catch, the arrangement being such that the separation may be made by a downward movement.

It will be clearly perceived that the violet light constituting the arc disappears at the moment when the current is interrupted.

This interruption may be repeated a large number of times per second (we shall presently recur to the use made of this fact in the division of electric light) so that the electrodes may be examined during the length of the interruptions only, by an apparatus somewhat resembling the phosphoroscope of M. Edm. Becquerel; the interruptions are effected by the apparatus itself, and thus the condition of the intervening space may also be examined during the same period. Economical motives have hindered me from realising this project, and I may here add that the kindness of M. Serrin first enabled me to effect the experiments which form the subject of this communication.

On a Mode of Dividing Electric Light.—The fact here admitted as the result of experience that, in order to produce electric light most advantageously it is necessary to employ a considerable number of elements arranged in series, may be of some theoretic consideration; operators usually employ fifty elements of Bunsen. Light may be produced by a much smaller number—twenty, for instance, —but the quantity of light produced is proportionately less, and the working condition arising from length of arc, regular consumption of charcoal, and exhaustion of pile, is much less favourable than when a larger number of elements are used.

On the other hand it is an advantage in many cases to be able to distribute the entirety of light yielded by a pile or electro-magnetic machine into several distinct lamps.

The only means which have been hitherto tried to my knowledge are, after dividing the source, the introduction of several arrangements into the same circuit, and the bifurcation of a single current into several lamps.

Thus, as to the division of light into two burners, and supposing the source to be a pile of fifty elements, either of the three following dispositions may be made.

1st method. Dividing the source.—Compose two piles of twenty-five elements each, and conduct each to a special electric burner.

2nd. By succession of burners.—Dispose the fifty elements in tension, and conduct the same current through the two arrangements successively.

3rd. Bifurcation.—Retain the fifty elements in tension and direct the current into two arrangements. We have already stated that the first system of two small piles was less advantageous with regard to the entirety of light than the ordinary system of one.

The second system has no advantage over the first, but possesses the disadvantage that if by any means the condition of one of the burners be altered, the other will sympathise; therefore, as from the very nature of all regulating apparatus hitherto known, the movement of the charcoal depends on the intensity of the current; movements induced by the state of the electrode in one regulator, will indubitably occur in the other if they be really equal. If one were more sensitive than the other it would be always separate, and consequently there would sometimes be a contact of the electrodes, and sometimes a rupture of the arc from too great elongation.

The third system by bifurcation or derivation has not the same drawbacks; the two arrangements do not influence each other in the same inconvenient way, but fall under the same conditions as to intensity as in the method of equal division of the source.

I have meditated dividing the current into periods, in order to separate the light into spaces, profiting by the power possessed by the arc of spontaneous re-establishment after an interruption of short duration.

Let us suppose that by means of appropriate mechanism the current is made to pass into one arrangement during 1-100th of a second, then during the next 1-100th into another arrangement, and again back to the first during the next 1-100th, and so on. As the duration of the interruption is short, the arc re-establishes itself spontaneously; and as it is also weaker than the permanency of the impression received by the retina, the arc itself being but a feeble source of light, the eye will consequently receive a sensation of continuity; moreover the incandescence of the electrodes varies only slightly. It is not to be denied that this experiment presents more theoretical than practical interest on account of the complication involved by the mechanism necessary to divert the current into sundry arrangements, nevertheless in some cases it may be found useful. The chief difficulty in applying it arises from the destructive action upon the distributive wheel of the sparks which arise in consequence of vibrations which it is impossible to quite avoid; the contact separates from the surface of the wheel; these sparks, which are so many voltaic arcs formed at the expense of the opposing surfaces, corrode and render them unequal, and aggravate the causes of interruption.*

If the apparatus works regularly the sparks will be feeble, but they will be altogether fatal if one of the burners should act alone, and this vexatious occurrence should be above all avoided, which may be easily done by arranging in such a way that if by any means one of the burners should be extinguished, the current should still find an outlet on that side.

To render the sparks as harmless as possible, it is a good plan to multiply the contacts, it being apparent that if instead of one spring we substitute two or more, there will be some chance that at least one may be always in perfect contact with the wheel. This, however, will not be the case if a cause of displacement, common to all, should arise, which is exactly what happens at every change in the teeth; for this reason only a small distance, not more than a millimetre, should be left between any two consecutive teeth, and the contacts should be arranged so as not to leave one tooth until they have slightly touched upon the next.

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* Experience has proved, in contradiction to a generally believed opinion, that it is better not to lubricate with any liquid the friction produced by the contact with the wheel; greasy bodies inflame at each spark, and thus augment its destructive effects by means of the developed heat; moreover, wear is not completely avoided, and the grease agglomerates the detached metallic particles in an inconvenient manner. In the dry friction the wear is more rapid, but it is regular, and the metallic dust is carried off by the disturbance of air; the general rule against the friction of two identical metals against each other must of course be obeyed, and the red copper contacts will succeed very well with the bronze wheel.

The surface of the contacts being more easily repaired than that of the wheel, it is preferable to cause communication between the former and the positive pole.

The vibrations of the contacts may be lessened with some success by mounting them upon springs composed of several thin plates, alternated with layers of gutta-percha.[*]

(To be continued.)

ON THE PURIFICATION OF RAW ANTIMONY.

This purification is effected by melting the raw antimony, containing copper, arsenic, lead, iron, and sulphur, with oxidising reagents (saltpetre or antimonic oxide), and with purifying reagents (carbonates of potash and soda), in order to oxidise and scorify the foreign metals; or these metals (iron, arsenic, lead, copper) are sulphuretted by a small addition of sulphide of antimony or Glauber's salts and coal, and are transformed into sulphides, when they combine with the slag. An addition of chloride of sodium transforms these metals into chlorides, and as such they either volatilise or become scorified. Antimonic oxide decomposes sulphide of antimony thus:—

$$3(SbO_3,SbO_5) + 4SbS_3 = 10Sb + 12SO_2.$$

The carbonate of soda reacting as a flux also decomposes sulphide of arsenic, forming carbonic acid, arsenious acid, and sulphide of sodium. Sulphide of sodium fluxes with FeS, Cu_2S, and AsS_3, whilst the arsenious acid combines with soda. A repeated smelting with soda is required for a complete removal of arsenic, which is facilitated by the presence of a small amount of iron, as a combination similar to arsenical pyrites is formed. Sulphide of iron must be added if the raw antimony does not contain iron. The purifying smelting is effected in crucibles, in reverberatory furnaces, or in air furnaces. In order to furnish the ingots with the star-like appearance on their surface necessary for commerce, the metal must be allowed to solidify under a cover or star slag, and all movement of the moulds must be avoided.

At the Enthoven lead works, near London, the raw metal is sorted according to the amount of iron it contains, which is judged by the appearance of the fracture. The pieces rich in iron are smelted together with the poor pieces, and 70 or 80 lbs. of this admixture, together with common salt, are kept in a fused state for one or one and a half hours. The smelted metal is poured into hemispherical iron moulds, and broken after the slag has been separated; the pieces are then carefully sorted to obtain a suitable admixture, and purified by being melted in quantities of 60 or 70 lbs., with 1 or 2 lbs. of American potash and 10 lbs. of slags of the same process. After smelting it is stirred with an iron rod, and the state of purification judged by the appearance of the slag. When slag is lustrous, and of a deep black colour, the metal is poured into moulds, and kept covered with slag until it solidifies. One labourer can turn out from 15 to 17 cwts. of metal in twelve hours.

At Septèmes and Bouc each crucible is charged with 44 lbs. of raw metal, 12 or 16 lbs of sulphate and carbonate of soda, mixed with some common salt, and very pure oxidised antimonial ore. Twenty of these crucibles are kept at a moderate red heat on the hearth of a reverberatory furnace for six hours, consuming 4 or 5 cwts. of coal. The refined metal is poured into moulds, forming ingots 20 or 24 lbs. in weight; the slag is removed after the ingots have cooled.

Many other methods of purification have been recommended. For instance, Wohler heats the metal with one part of sulphide of antimony, one and a quarter parts of saltpetre, and one and a half parts of potash, and lixiviates with water for the extraction of arseniate of potash; he then reduces the residue with half a part of tartar. Meyer recommends heating with a quarter of a part of soda-saltpetre, and half a part of carbonate of soda, washing with water, and melting the residue with tartar. Schiel recommends the melting of sixteen parts of regulus with one and a half parts of soda, repeatedly adding some saltpetre, and stirring with a clay rod. Berzelius melts two parts of metal with one part of oxide of antimony. Muspratt melts four parts of antimony with one part of manganese, and repeatedly melts the resulting regulus with 0·1 part of potash.

ON FOOD.[*]

By DR. LETHEBY, M.A., M.B., &c.

(Continued from page 176.)

Functions of Different Foods.

Functions of Fat.—The hydrocarbons which go by the name of fat differ from other hydrocarbons, as sugar and starch, in the circumstance that the oxygen is never in sufficient quantity to satisfy the affinity of the hydrogen; and, therefore, fat is more energetic as a respiratory or heat-producing agent. Its power, indeed, in this respect is just twice and a half as great as that of starch or sugar; for 10 grains of it will, by combining with oxygen, develope sufficient heat to raise 23·2lbs. of water 1° F.; and according to the deductions of both Joule and Meyer, this is equivalent to the power of raising 17,923 lbs. one foot high. In cold countries, where animal warmth is required, food rich in fat is always preferred; and the fat bacon of the English labourer contributes in no small degree to the production of mechanical force.

But besides this, fat serves important functions in the processes of digestion, assimilation, and nutrition. According to Lehmann, it is one of the most active agents in the metamorphosis of animal matter; and this is seen not merely in the solution of nitrogenous articles of food during digestion, but also in the conversion of nutrient plastic substances into cells and masses of fibre. Elsässer long since observed that during the process of artificial digestion, the solution of nitrogenous foods was considerably accelerated by means of fat; and Lehmann has since determined, by actual experiment on dogs, that albuminous substances deprived of fat remain longer in the stomach and require more time for their metamorphosis than the same substances impregnated with fat. It is probable, indeed, that the digestive power of the pancreatic fluid is due in great measure to the presence of fat; and that the subsequent chymification of food, and its absorption into the blood, is greatly assisted by it. There is also good reason for believing that it is largely concerned in the formation of bile, and that the biliary acids are conjugated fatty compounds. This may account for the well-known action of fat bacon, and other such foods in promoting the secretion of bile.

The digestive power of fat is certainly considerable; and it is no less active in the subsequent conversion of nitrogenous matters into cells and tissues, and perhaps also in effecting their retrograde decay. Colourless blood corpuscles receive perhaps the first impulse of their formation from the metamorphosis of fat; and thus it may be an important aid in the genesis of blood. It would appear, too, from the latest investigations of physiologists, that it plays an equally important part in every kind of cell development. Acherson showed, as far back as 1840, that albumen always coagulates from its solution around a fat globule, and this is seen in the little fatty particles of milk, which have a covering like a cell-wall of consolidated casein. Hunefield, Nasse, and others, have further shown that the nucleoli of cells invariably consist of fat, and that recently-formed plasma always contains more fat than the mature cell. The conclusion, therefore, is that it takes an active part in all the processes by which the nutrient constituents of food are converted into the solid substrata of organs; and so energetic are its powers in this respect, that when the nitrogenous matters of the fluids are not in sufficient quantity to form cells with the fat, it borrows the material from muscular or other tissues, and thus produces a fatty degeneration of the part. This is observed in the muscular structures of over-fed animals, in the tissues of drunkards, who take a large amount of fat-forming food, and in the livers of geese that are crammed with a farinaceous diet.

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[*] These considerations of course apply to cases where a pile is used as the source of electricity; if a magneto-electric machine be employed, it must be arranged in a peculiar manner. The mean tension of the machines usually employed is known to be so weak as to produce only an arc of short extent, and as experience shows that the bifurcating system described necessitates a reduction in the length of the arc, the machines should be so managed as to present a higher degree of tension; it will be as well to arrange the distribution in such a manner that it should occur at the moment when the current is at the minimum in order to avoid the intensity of the sparks.

[*] The Cantor Lectures, delivered before the Society of Arts.

And not only is it concerned in the formation of new tissue, but it also pervades, and finally disintegrates the older structures, especially when the vitality of them is low. In this manner it helps in the solution and subsequent removal from the animal body of decayed and morbid products of the protein type.

Again, its presence in large quantity in the tubules of nerves, and in the ganglionic centres, would indicate that it performs some highly important functions in nervous action.

And lastly, the distribution of it in the tissues, and the accumulation of it around certain organs, serve to fill up the vacuities of the body, to give rotundity to the form, to equalise external pressure, to diminish the friction of parts, to give suppleness to the tissues, and by its bad conducting property to retain the animal warmth. Fat, therefore, must always enter largely into the composition of our food; for other hydrocarbons, though capable of transformation into fat, cannot entirely take its place.

3rd. *Starches and Saccharine Substances.*—These are well called hydrates of carbon, for the oxygen and hydrogen contained in them are nearly always in the proportion to form water. The carbon, therefore, is alone capable of oxidation, and according to Liebig their functions are entirely calorific or respiratory; but, like other heat-producing agents, they must also have mechanical power, for everything that will raise the temperature of a pound of water one degree of Fahrenheit will, by another modification of its action, raise 772 lbs. a foot high. The energies, however, of this class of substances are not nearly so great as with fats, for in the last case, as I have said, there is much available hydrogen, as well as carbon, for oxidation. The diagram which is before you will make this clear.

Calorific and Motive Powers of 10 Grains of the Substance in its Natural State.

	Lbs. of water raised 1° F.	Lbs. lifted 1 foot high.
Grape sugar	8·4	6,477
Lump sugar	8·6	6,617
Arrowroot	10·0	7,731
Butter	18·6	14,358
Beef fat	20·9	16,131

So that, in round numbers, the calorific power of fat is about twice as great as that of starch and sugar, and when dry it is twice and a half as great.

But these substances have other duties to perform besides the development of animal heat, which is, in fact, the final product of their oxidation, for on becoming changed into glucose by digestion they take the form of various acid compounds, as lactic acid, which occurs in the stomach and in the juice of flesh; butyric, formic, and acetic acids, which are found in the perspiration. The exact functions of these acids are not known to us, although, as I have already explained, the presence of lactic acid in the stomach is essential to the digestion of nitrogenous matters; and perhaps also its occurrence in the juice of flesh is for a similar object—viz., the solution of effete tissues.

Starches and sugars are also concerned in the production of fat. This was once the subject of an animated discussion by Liebig and Dumas, whose views of it were in complete antagonism; but the experiments of Boussingault, Persoz, Lawes, and others on the feeding of animals, have proved beyond all question that fat may be derived from the hydrates of carbon, and that therefore the views of Liebig were correct. Common experience, indeed, has fully taught us that foods which are rich in farinaceous matters and sugar are very capable of producing fat.

4th.—The saline or mineral constituents of food are largely concerned in the metamorphosis of matter; and, perhaps, this is their sole function. It is a specialty of these substances to give a soluble form to the plastic constituents of food, and of the animal tissues. They are, therefore, concerned in the phenomena of digestion, absorption, sanguification, assimilation, disintegration, and secretion. In truth, they are the chief, if not the only, media for the transference of organic matter from place to place in the animal body—being, on one hand, the purveyors of nutrient materials into the system, and on the other, the carriers of effete substances out of it; besides which, it is very probable that they are the agents whereby liquid colloidal forms of nutriment are changed into solid or pectous, as in the formation of solid tissues from the blood. In the case of digestion and absorption the plastic elements of our food, as albumen, fibrin, gelatin, &c., are not of themselves capable of dialysis, or of passing through the walls of the alimentary canal; and, therefore, absorption must be assisted by some physical agent. This agent is the highly diffusive acids and salts which are secreted so freely into the stomach during digestion; and it is very probable that they not only effect a solution of the proteinaceous matter of food, but, by converting it into peptones, as Lehmann expresses it, they also change the melecular form of the material, and make it pass from an unabsorbable colloid into a highly diffusive crystalloid. If, indeed, it be, as Mr. Graham supposes, that a colloid molecule is but a group of smaller crystalloids, the action of the saline and acid constituents of the gastric juice might be to break up the larger colloid molecule, and thus give it the property of diffusion and absorption. An opposite condition of things would occur in the alkaline blood, whereby the colloid molecule would regain its structure, and lose its diffusive tendency; but, coming to the tissues, where an acid condition of the fluids again exists, it once more changes its molecular structure, and quits the blood to serve the purposes of nutrition. The exact nature of the phenomena that occur when the liquid nutrient matter which thus escapes is changed into solid tissue is unknown to us; but there is good reason for believing that it is no more than a molecular movement effected by the agency of saline matter. In the case of certain structures which contain more than a common amount of mineral salts, this is unquestionably so, for it occurs in the consolidation of the spiculæ of sponges, the calcareous tissues of polypes, the hard dermal structures of the radiata, mollusca, crustacea, &c., and in the calcareous deposits of bone, teeth, tegumentary scales, egg-shells, &c., of the vertebrata. In all these instances the secreted matter must first have been crystalloidal, or it could not have been secreted; it then takes the form of a liquid colloid or jelly; and finally, by a further molecular movement, it passes into the condition of a pectous solid—the saline constituents, according to their nature and proportion, determining the degrees of hardness.

Again, the removal of effete matters and worn-out tissues is undoubtedly effected by the agency of saline substances; for, during the processes of oxidation, acid compounds are produced, which, by acting chemically on the saline constituents of the animal fluids, give them a solutive power on plastic matters, and thus enable them to remove the *débris* of worn-out tissue.

As to special functions of the several saline constituents of food, little can be said; but it is a remarkable fact that the alkaline or basic phosphate of soda is invariably found in the blood, while acid phosphate of potash is the chief constituent of the juice of flesh. Most likely the former is concerned in preserving the liquid colloidal condition of albumen and fibrin, and so keeping them from being lost by secretion, while the latter is engaged in an opposite duty. The alkalinity of the blood also helps in the oxidation of organic matters; and as the basic phosphate of soda is endowed, like an alkaline carbonate, with the power of absorbing carbonic acid, it is the chief agent whereby this compound is removed from the system. This is a remarkable property, and is one of the chief uses of basic phosphate of soda in the blood. In point of fact, when it is not there in sufficient quantity to perform this function, it is replaced by an alkaline carbonate. We find this to be so in the blood of herbivorous animals, where the proportions of the two salts are the reverse of what they are in man and carnivora. Some notion may be formed of the relative importance of the saline matters of the blood by reference to this diagram from Liebig.

PERCENTAGE COMPOSITION OF THE MINERAL MATTERS OF BLOOD.

	Man.	Pig.	Dog.	Fowl.	Sheep.	Ox.
Phosphoric Acid..........	31·79	36·50	36·82	47·26	14·80	14·04
Alkalies..................	65·66	49·80	55·24	48·41	55·79	60·00
Alkaline Earths	3·33	3·80	2·07	2·22	4·87	3·64
Mineral Acids and Oxide of Iron	9·22	9·90	5·87	2·11	24·54	22·32
Total	100·00	100·00	100·00	100·00	100·00	100·00

And in those cases where the phosphoric acid is deficient, it is replaced by carbonic acid. In man, for example, the quantity of combined carbonic acid in the ashes of the blood is only 3·78 per cent, whereas in the calf it is 9·85, and in the sheep 19·47 per cent, so that in all cases the alkalinity of the blood remains the same.

The salts of potash in the juice of flesh have, no doubt, an equally important duty to perform, although of an opposite character; for while the alkaline phosphate of soda in the blood prevents the transudation of nutrient matter, the acid phosphate of potash in the muscular fluid promotes it; and thus it is concerned in nutrition and in the solution of worn-out tissues.

Earthy phosphates, especially phosphate of lime, are, perhaps, the agents for the consolidation of tissue; for not only are they present in the hard structures of the body, as the bones and teeth, but they also enter into the composition of flesh.

And not less important in the morphological functions of the animal body is the presence of common salt. It is a large constituent of every one of the secretions, and forms about half the total weight of the saline matters of the blood. Unlike the phosphates, however, it does not enter into the composition of tissue, but seems to be only a medium of absorption and secretion; and so necessary is it for this purpose, that it is not possible to alter, to any large extent, its proportion in the blood. If we drink water containing but little common salt in solution, it does not permanently dilute the blood, but passes off immediately by the kidneys; and if we try to increase the amount in the blood by drinking solutions of salt, as sea water, it refuses to be absorbed. This normal proportion of it in the blood is evidently a physiological necessity, which the conditions for diffusion imperatively demand. It is a curious fact, also, that common salt has the faculty of forming crystallisable compounds with most of the unorganised and effete constituents of the body. May it not, therefore, be an important agent of diffusion, and be thus concerned in the phenomena of absorption and secretion; for as colloidal matters—albumen and fibrin—cannot pass through the walls of the intestines, or the blood-vessels, it may well be that through the agency of common salt and the free acid of the gastric and muscular juices, they temporarily assume a crystalloidal condition, and are thus absorbed or secreted.

The constant presence of common salt in the secretions, and the necessity for it in due proportion in the blood, indicate the importance of a proper supply of it with the food. We perceive this in the instinct of animals, and in our own craving for it when it does not exist in sufficient quantity in the food. Animals, in fact, will travel long distances, and brave the greatest dangers, to obtain it. Men will barter gold for it; indeed, among the Gallas, and on the coast of Sierra Leone, brothers will sell their sisters, husbands their wives, and parents their children, for salt. In the district of Accra, on the Gold Coast of Africa, a handful of salt is the most valuable thing upon earth after gold, and will purchase a slave or two. Mungo Park tells us that with the Mandingoes and Bambaras the use of salt is such a luxury that to say of a man "he flavours his food with salt," is to imply that he is rich; and children will suck a piece of rock-salt as if it were sugar.

The experiments of Boussingault have shown that, although salt mixed with the fodder of animals does not much effect the quantity of flesh, fat, or milk obtained from them, yet it seriously affects their appearance and general condition; for animals deprived of salt, other than that contained naturally in the food, soon get heavy and dull in their temperament, and have a rough and staring coat. Reulin states that animals which do not find it in their food or drink, become less prolific, and the breed rapidly diminishes in number. This is confirmed by Dr. Le Saine, who says, in his prize-essay on salt, that it increases the fertility of the male and the fecundity of the female, and it doubles the power of nourishing the fœtus. During the period of suckling, also, salt given to the mother renders the milk more abundant and more nutritious. It likewise accelerates growth, and gives a finer condition to the skin; and the flesh of animals fed with it is better flavoured and more easily digested, than that of animals which do not partake of it. In barbarous times, the most horrible of punishments, entailing certain death, was the feeding of culprits on food without salt; and in the experiments of the French Academicians, flesh deprived of its saline constituents by being washed with water, lost its nutritive power, and animals fed on it soon died of starvation. Even after a few days, with such a diet, the instincts of the animals told them it was worthless as food; indeed, for all purposes of nutrition, it was, as Liebig says, no better than the eating of stones, and the utmost torments of hunger were hardly sufficient to induce them to continue the diet. There was plenty of nitrogenous matter in the food, but there was no medium for its solution and absorption, and hence it was useless.

The oxides of iron, and their homologues, the oxides of manganese, are largely concerned in the processes of sanguification and oxidation. They enter into the composition of the globules of the blood—manganese being the chief mineral constituent of the corpuscles of white-blooded animals, and iron of red. In fact, the colouring-matter of the blood discs (cruorin), as well as that of the muscles (myochrome), is a compound of iron and albumen (globulin), which has a remarkable property of absorbing oxygen when exposed to the air, and of giving it out again in the presence of reducing agents. In the one case it acquires an arterial tint, and in the other a venous; and the spectrum informs us that these two conditions of it are easily assumed—one by the presence of atmospheric oxygen, and the other by decaying organic matter. It is hardly to be doubted that these are the conditions of it in blood—the bright red oxidised cruorin being the form of it in arterial blood, and the dark reduced variety of it in venous. The functions, therefore, of both cruorin and myochrome are entirely of a respiratory nature; for in the former case it is the medium whereby oxygen is absorbed from the air in the lungs, and is carried with the blood-discs throughout the body, and in the latter it may be the agent of interstitial oxidation.

Lastly, there is a mineral constituent of our food, silica, which enters into the composition of all the tegumentary appendages. Its presence is not of so much importance to us as to the lower animals, whose warmth is retained by a natural covering of hair, or wool, or feathers. In the case of birds, indeed, the quantity of silica in the feathers is very considerable, and Gorup-Besanez has described its physiological relations.

As to the proportions of mineral substances required in the food, it is difficult to speak. Dr. Edward Smith says that an adult man requires daily from 32 to 79 grains of phosphoric acid; from 51 to 175 grains of chlorine (equal to from 85 to 291 grains of common salt); from 27 to 107 grains of potash; from 80 to 171 of soda; from 2·3 to 6·3 of lime; and from 2·5 to 3 of magnesia. According to Mr. Lawes, a very small portion of these salts is retained in the system; for in fattening pigs he found that of every 11 lbs. of mineral matter contained in the food only 12 ozs. were stored up in the body, and this was chiefly the earthy phosphates, all the rest being either unabsorbed, or else used in the work of absorption, assimilation, and secretion. In most cases, therefore, there is sufficient saline matter, excepting common salt, in all ordinary food; but for all this, the presence of it in the water we drink is not an unimportant question. Four-fifths of the earth's surface are composed of calcareous strata, which yield water that is more or less rich in carbonate or sulphate of lime; and it may well be that this is a wise provision for the supply of these salts to the animal system. As Mr. Johnston has truly observed in his "Chemistry of Common Life," "The bright sparkling hard waters which gush out in frequent springs from our chalk and other lime-stone rocks are relished to drink, not merely because they are grateful to the eye, but because there is something exhilarating in the excess of carbonic acid they contain and give off as they pass through the warm mouth and throat; and because the lime they hold in solution removes acid matters from the stomach, and thus acts as a grateful medicine to the system. To abandon the use of such a water, and to drink daily in its stead one entirely free from mineral matter, so far from improving the health, may injure it;" in fact the water of a country may determine the diet of its inhabitants. The soft waters of the lakes of Scotland, for example, may have had something to do with the choice of brown meal; and but for the calcareous waters of Ireland the potato could not have become a national food.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL SOCIETY.

The opening meeting of the session was held on Wednesday evening, October 7th, under the presidency of G. W. Sandford, Esq. There was a very large attendance, and, for the first time, the meeting was honoured with the presence of a goodly number of ladies. We hope the council will in future invite ladies to their *conversazione* as well as to their opening meetings, for their presence always lends a charm to the proceedings, and has, we are sure, an influence for good on the students.

At no period of the history of this society has there been more cause for congratulation than the present. For twenty-eight years the council have laboured hard to promote the interests of pharmacy, and to render examination compulsory on those who shall carry on the business of a chemist and druggist. The attainment of this object by the Pharmacy Bill which passed both Houses of Parliament during the last session was, of course, a cause for rejoicing at this the first meeting of the society since the passing of the Act.

The President called upon the professors to announce the results of their respective examinations at the close of the last session, and it was highly gratifying to hear them speak in such high terms of the conduct of the students. Whether in the lecture theatre, the botanical gardens, or the laboratory, they had not only conducted themselves well and gained the praise of those who had had an opportunity of watching their behaviour and comparing it with students at other schools, but they also went through their studies with real earnestness, determined to make the best use of their time, and to gain as much knowledge as they could. With regard to the prizes, medals, and certificates, they were never better merited than during the last session. The President then distributed the prizes, and called upon Mr. H. B. Brady, of Newcastle, to deliver an inaugural address. We congratulate the council on their choice of one so peculiarly fitted to open the session at such an important time as the present. The address is quite as applicable to students in our schools of chemistry as to pharmaceutical students, and we trust our short report may lead some to enter into their studies with renewed energy, bent upon searching into the mysteries of that branch of science to which they are giving their special attention.

Mr. Brady began by making a few observations on the present aspect of pharmacy in its social and ethical relations; they were no longer a mere voluntary association as they had been stigmatised in the House of Commons during the late debate, but now occupied the same relation to Government as other professional bodies who hold examining powers, the Legislature having, with general approval, given them, as a body, a certain monopoly on an educational basis, as it had done heretofore to lawyers, surgeons, and others; they had, however, with their new powers and improved position new and increased responsibilities. Those who had given them new powers looked for an advantage in having a specially educated body of men to perform certain duties, and it was for them to qualify themselves for the enlarged sphere opened to them. No mere curriculum of college instruction could impart that sort of intellectual cultivation and tone of thought that places a man above the category of tradesmen, but they must qualify themselves by closer mental training for that higher social position which it would be their own fault if they did not occupy. In speaking of systematic study, Mr. Brady said it was in after life that the man who had done his elementary work well, systematically reaped its full advantage; for he had ready a framework more or less elaborate in which each new truth finds a natural place. The amount of detail a student could impart to his work was, no doubt, partly dependent on the opportunities at his disposal and the bent of his mental powers, but its accuracy and usefulness depend on conditions entirely within his own command, and the first in importance was system, or regularity in the attendance of lectures, demonstrations, and laboratory practice. Each step in scientific knowledge is dependent upon the one that precedes it, and bears an equally close relation to that which follows. To miss a single lecture in a course consisting of a hundred seemed a trifling matter, but the real loss could not be measured by mere numerical proportion. It might easily happen that an acquaintance with a principle expounded in the neglected discourse is essential to the proper comprehension of many that follow. A German author, Richter, speaking of this sort of steady persistence in following out a well-devised course of education, concluded a paragraph by saying that—"Regularity is unity, unity is God-like; only the Devil is changeable."

The speaker then impressed upon the students the necessity of being *thorough*, not to be content with surface work, not to accept the appearance for the reality, the gilt for the gold. In learning a principle, they must strive to know the phenomena from which it has been deduced; in the acquirement of facts, they must seek to associate them with the laws by which they are explained. It could not be too often repeated that there is no royal road to knowledge; and the many tempting bye-ways that diverge from the straight course—green, sunny, and seductive—that promise to lead to the same goal, soon show, though winding and deceptive, and not easily traced, that to whatever end they do lead it is not the one desired. You may know them only by one fact—they always tend, just a little, downwards. The right road is up-hill—rough near its outset, and marred by obstacles that at a little distance look formidable. These are surmounted by toil and perseverance, but the achievement brings new spirit into the work, the bye-ways lose their fascination, and new difficulties are sought rather than avoided. The condition in which the drudgery of the onset becomes a labour of love is attainable by all; and until it is attained scientific progress is hard and uncertain. Mr. Brady then gave some useful advice on recreation, cultivating a taste for literature and general science, &c., and closed a most instructive and practical address by referring to the history of William Allen, F.R.S., the first president of the Pharmaceutical Society, whose youth gave him no special advantages, but who had to *work his way* to succeeding positions of increased responsibilities in that well-known pharmacy at Plough-court with which his name is inseparably connected, and who, by diligence, devotion, and earnestness, became the man of science whose memoirs on carbon, on carbonic acid, and on respiration, were amongst the finest researches of their day—who became the friend and associate of Davy, Wollaston, Berzelius, De Luc, and others of that noble fraternity of chemists and physicists,—the brilliant and fascinating lecturer on chemistry at Guy's Hospital and the Royal Institution,—and the philanthropist labouring hand in hand with Clarkson, Brougham, Wilberforce, and the rest of that devoted band, to whom civilisation owes the suppression of the slave trade, the amelioration of a barbarous penal code, and the initiatory steps in the spread of education.

FOREIGN SCIENCE.

PARIS, OCT. 14, 1868.

ACADEMY OF SCIENCES:—Hydrides of Hydrocarbons (Styrolenic series).—Volumetric Determination of Zinc.—Chlorosulphuric Ether.—Action of Zinc Ethyl on Bichlorinated Acetal.—Bichlorinated Aldehyd.—Colouration of Peroxide of Nitrogen.

FRENCH chemists' minds have been so fertile lately that my communications for some time will be little more than abstracts of the *Comptes Rendus*. The following memoirs were brought forward on the 10th of August:—"Determination of the Number and the Laws of the Variation of Co-efficients of Elasticity for Solid Heterogeneous Bodies," by M. Gosiewski; "On the Hydrides of Hydrocarbons (Styrolenic series)," by M. Berthelot; "Coloured Reactions of Aniline, of Pseudo-toluidine, and of Toluidine," by M. Rosenstiehl; "On the State of Salts in Solutions," by M. Méhay.

M. Berthelot commences his memoir with the analytical proof that ethylbenzol is hydride of styrolene, in confirmation of the results already obtained by synthesis. Action of heat on ethylbenzol. The vapour of this compound made to pass through a porcelain tube heated to moderate redness is nearly totally decomposed; the most abundant product of the reaction being styrolene—

$$C_{12}H_4(C_4H_6) = C_{12}H_4(C_4H_4) + H_2.$$

Its formation in great quantity is characteristic of ethylbenzol, and distinguishes this from xylene or dimethylbenzol, the isomeric hydrocarbon. Although in smaller proportion, benzol is formed simultaneously with styrolene—$C_{13}H_4(C_4H_6) = C_{12}H_6 + C_4H_4$. These are the most abundant, and to some extent the normal products of the decomposition of ethylbenzol; but, as in most organic reactions, secondary products are formed. Among the secondary products is toluine, or methylbenzol—$C_{14}H_8$, or $C_{12}H_4(C_2H_4)$. The proportion of this body formed in M. Berthelot's experiments amounted to about one-third that of the styrolene. Naphthaline, $C_{20}H_8$, and hydride of naphthaline, $C_{20}H_{10}$, were also detected. The action of a red heat transforms then a small portion of ethylbenzol into dimethylbenzol by a sort of molecular transposition, which results from the metamorphosis of an ethylenic residue decomposed into two more stable methylenic residues, $C_{12}H_4(C_4H_6) = C_{12}H_4[C_2H_2(C_2H_4)]$.

The formation of styrolene by the humid method is effected by aid of the ether, which is prepared by reacting upon boiling ethylbenzol with bromine vapour. To transform this ether into styrolene. it is only necessary to remove the elements of the hydrobromic acid—

$$C_{12}H_4[C_4H_4(HBr)] - HBr = C_{12}H_4(C_4H_4).$$

When the ether is made to act at 180° upon alkaline acetates or benzoates, a small quantity of styrolene (also metastyrolene) is formed, while styrolacetic and benzoic ethers are the principal products—

$$C_{12}H_4[C_4H_4(HBr)] + C_4H_3NaO_4 = C_{12}H_4(C_4H_4) + C_4H_4O_4 + NaBr.$$

This secondary reaction which furnishes the hydrocarbon, M. Berthelot remarks, he has observed for a long time, is produced upon nearly all hydrochloric and hydrobromic ethers of true alcohols. Styrolene appears again as a secondary product, and together with ethylbenzol, in the reaction of sodium on styrolhydrobromic ether—

$$2C_{12}H_4(C_4H_5Br) + Na_2 = C_{12}H_4(C_4H_4) + C_{12}H_4(C_4H_6) + 2NaBr.$$

But it is the reaction of an aqueous solution of potash upon this ether at 180° which furnishes the largest amount of styrolene. In this reaction the hydrocarbon is changed first, under the influence of heat and the alkali, into metastyrolene. In distilling the hydrocarbon produced, one obtains above 300° a mixture of styrolene regenerated from its polymer, and an oxygenated body (probably styrolenic ether, $C_{32}H_{18}O_2$). By redistillation, styrolene with all its characters is obtained.

On the 17th of August, M. Nicklès communicated a memoir "On Manganoso-Manganic Fluoride"; M. Renard, a memoir "On the Volumetric Determination of Zinc." The following were also brought forward at this meeting:—"On Chlorosulphuric Ether," by M. de Purgold; "On the Condensed Ureas," by M. Schiff (second memoir); "Action of Zinc-Ethyl on Bichlorinated Acetal," by M. Paterno; "On Bichlorinated Aldehyd," by M. Paterno.

M. Renard's volumetric process of determining zinc depends upon the following reactions:—When in a determinate quantity of a solution of yellow prussiate of potash the solution of a zinc salt is added, the whole of the zinc is precipitated as double ferrocyanide of zinc and iron, completely insoluble in ammoniacal water. By determining with the aid of permanganate of potash the excess of prussiate of potash employed, the amount of zinc is obtained by calculation. To assay a mineral, one or two grammes are dissolved in aqua regia, ammonia added, the solution filtered from the precipitate, and the latter washed. To the filtered part, 25 c.c. of a solution of ferrocyanide of potassium (150 grammes to the litre) are added; the solution is made up to 250 c.c., filtered, 100 c.c. of the filtrate are measured into a glass vessel, and neutralised with pure hydrochloric acid free from chlorine and sulphurous acid. Afterwards the solution is rendered strongly acid with about 30 c.c. of this same acid, and titrated permanganate solution added until the whole of the yellow prussiate is transformed into red prussiate. By calculation the amount of zinc contained in the mineral is arrived at. None of the metals commonly present in minerals, such as iron, alumina, manganese, lead, &c., influence the process. Either they are precipitated by the ammonia, or in the case of others—lead, for instance, the oxide of which is soluble—they are not precipitated by ferrocyanide of potassium. Copper is an exception.

When chloric ether is brought in contact with anhydrous sulphuric acid at zero, this solid gradually liquefies. Heating to 100° causes the mixture to become brown and disengage sulphurous acid; but when it is poured drop by drop into water at zero, a heavy stratum of oil is formed, which, washed and dried upon chloride of calcium, is already deprived of the unchanged sulphuric acid and chloric ether. This oil is decomposed by distillation at the ordinary pressure, a little above 100°. In the vacuum it passes over almost entirely from 70° to 110°. A slight oily and coloured residue remains. The greater portion distils between 70° and 90°. After several rectifications, a liquid is obtained which boils in vacuo at 80° to 82°. Analysis gave numbers corresponding sufficiently closely with the formula $C_2H_5ClSO_3$. This substance is then the result of the addition of chloric ether to anhydrous sulphuric acid. The body decomposes partially at each distillation, evolving a little hydrochloric acid, and the residue becomes thereby enriched in free sulphuric acid. The oil is nearly insoluble in water; it dissolves in hot water, decomposing slightly. Heated with water in a sealed tube to 100° it gives ordinary ether, a little chloric ether, and hydrochloric acid, while the whole of the sulphur passes into the state of sulphuric acid. With alcohol the same reaction is produced, but the alcohol reproduces chloride of ethyl. With acetate of soda in concentrated aqueous solution, acetate of ethyl, sulphate of soda, and free acetic acid are produced. These various reactions lead to one of the three following isomeric formulæ:—

$$\overbrace{C_2H_4ClSO_2OH.}^{\text{Chloroisethionic acid.}} \qquad \overbrace{C_2H_4(OH)SO_2Cl.}^{\text{Chloride of isethionyl.}} \qquad \overbrace{C_2H_5OSO_2Cl.}^{\text{Chlorosulphuric ether.}}$$

M. de Purgold has verified the third hypothesis.

Zinc-ethyl does not act at the ordinary temperature on bichlorinated acetal, even after several day's contact; but if the mixture of the two compounds be heated to 140° in a cohobating flask, an action is manifest by the regular evolution of gas, and as a residue ether mixed with oxide and chloride of zinc is obtained. Upon passing the gas through a tube surrounded by a freezing mixture, and afterwards into bromine, in the cooled receiver, M. Paterno collected chloride of ethyl; the bromine absorbed a portion of gas which had not condensed. The bromine thus obtained boiled between 130° and 142°; it yielded by analysis, for the bromine, numbers intermediate between those required by theory for bromide of ethylene and bromide of propylene. The gases not absorbed by bromine were considered to be due to secondary reactions.

M. Lieben having demonstrated that by the action of chlorine on hydrated alcohol the chlorinated derivatives of acetal were formed, explained the formation of chloral by the action of chlorine on absolute alcohol, by supposing first the formation of trichlorinated acetal, and afterwards by the action of hydrochloric acid, the splitting up of the trichlorinated acetal into chloride of ethyl and trichlorinated aldehyd (chloral). This explanation is confirmed, on the one side by the fact observed by M. Stas, of the existence of acetal among the products of the action of chlorine on alcohol; and on the other side, by the decomposition observed by M. Wurtz and by M. Beilstein, of acetal in contact with acetic acid, into ethylic acetate and aldehyd. M. Paterno proposed to himself the verification by experiment of M. Lieben's supposition, by studying the transformation of the chlorinated derivatives of acetal in presence of acids, and at the same time preparing by this means the chlorinated derivatives of aldehyd that have not been directly obtained. The bichorinated acetal, which is easily prepared by the action of chlorine on alcohol at 80°, was chosen for the experiments. M. Paterno submitted this bichlorinated acetal to the action of sulphuric acid, and thus obtained bichlorinated aldehyde, CCl_2HCOH, isomeric with chloride of chloracetyl, $CClH_2COCl$, obtained by M. Wurtz. This reaction confirms the supposition, that in bichlorinated acetal the two atoms of chlorine are united to the same atom of carbon, analogous to that observed in other chlorinated products of the fatty series. The following are details of the experiments:—In the preparation of the bichlorinated aldehyd, a mixture of bichlorinated acetal with four to six volumes of ordinary sulphuric acid, was distilled; the distillation is most conveniently made with an oil bath heated to 130°. The distillate requires several rectifications; that which passes over between 88° and 90° is pure bichlorinated aldehyd. It constitutes a very mobile liquid, heavier than water, in which it is soluble; it dissolves also in alcohol and in ether. A portion of this liquid preserved in a sealed tube suffered no change; but another portion, preserved in stoppered flasks, became thick, and finally assumed the form of a white amorphous solid. This modification of bichlorinated aldehyde, corresponding probably to the insoluble chloral, heated to about 120°, distils regenerating liquid bichlorinated aldehyd. The analytical results and the vapour density of the product agreed with the requirements of the formula, $C_2H_2Cl_2O$. These experiments were made in the laboratory of the University of Palermo, under the direction of M. Cannizzaro, and will be continued.

The only paper of chemical interest presented at the meeting on the 24th of August was a note "On the Colouration of Peroxide of Nitrogen," by M. Salet.

The vapour of peroxide of nitrogen (hyponitric acid) presents some remarkable peculiarities. Its density decreases rapidly up to 43°; then this decrease becomes less noticeable, and at 150° is *nil*. At the same time the vapour assumes a deeper and deeper tint. M. Wurtz supposes that the molecule of peroxide of nitrogen at a low temperature contains $N_2O_4 = 2$ volumes, and that when heated it is gradually dissociated into two molecules of NO_2, occupying each two volumes. M. Salet states the following hypothesis:—"Since the peroxide of nitrogen is colourless at a temperature at which its vapour density corresponds truly to the formula N_2O_4, and since it becomes coloured in proportion as the temperature at which the molecular condensation corresponds to the formula NO_2 is approached, let us suppose that N_2O_4 is colourless and that NO_2 is coloured." M. Salet has verified this hypothesis experimentally.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Xylolsulphurous Acid and Derivatives of Benzol.—F. Lindow and R. Otto. Xylol, of the boiling point 139°—141° C., obtained by fractional distillation of coal-tar oil, was converted into sulphoxylolic chloride and then by means of sodium amalgam into xylolsulphurous acid. The latter thus obtained is a slightly yellow, nearly odourless oil, soluble in ether, benzol, and alcohol, insoluble in boiling water. When exposed to air it is gradually oxidised to xylolsulphuric acid. The action of chlorine upon xylolsulphurous acid is represented by the following equation:—

$$C_8H_{10}SO_2 + 2Cl = HCl + \left.\begin{matrix} C_8H_9SO_2 \\ Cl \end{matrix}\right\}$$

Nascent hydrogen converts it into xylilic sulphydrate:—

$$C_8H_{10}SO_2 + 4H = 2H_2O + \left.\begin{matrix} C_8H_9 \\ H \end{matrix}\right\} S$$

Fusing potassic hydrate decomposes it without the formation of any by-product into sulphurous acid and xylol:—

$$C_8H_9KaSO_2 + KaHO = SKa_2O_3 + C_8H_{10}.$$

When heated with water in a sealed tube xylolsulphuri acid and oxyxylylic disulphide, $C_{16}H_{18}S_2\Theta_2$, are formed. The latter on being treated with zinc and sulphuric acid is readily converted into xylylic sulphhydrate. An alcoholic solution of xylolsulphurous acid is energetically acted upon by nitrous acid, and after a prolonged treatment the solution contains nitrosulphoxylylic acid.

If 1 molecule of sulphobenzolic amide and 2 molecules of potassic hydrate are heated together to the fusion temperature of the amide, a violet reaction takes place, the product of which the author believes to be a substituted amide having part of its typical hydrogen replaced by potassium. It is soluble in water, and on addition of acids the original sulphobenzolic amide is precipitated. On heating the mixture to 250°—300° the amide is decomposed into sulphurous acid and phenol:—

$$\left.\begin{matrix}C_6H_5S\Theta_2\\H_2\end{matrix}\right\}N + 3KaH\Theta = NH_3 + \left.\begin{matrix}C_6H_5\\Ka\end{matrix}\right\}\Theta + SKa_2O_3 + H_2\Theta.$$

—(*Zeitschr.* Ch. N.F. iv., 37).

Formation of Argentic Peroxide by Ozone.—F. Wöhler. If an electric current from a couple of cells of Bunsen's battery, the positive pole of which consists of a silver plate, is made to pass through water acidulated with sulphuric acid, the silver becomes covered with a black coating of amorphous argentic peroxide. The formation of this oxide is due to ozone, for on substituting a platinum foil for the one of silver the smell of ozone may be at once recognised. The same phenomenon takes place if instead of acidulated water a solution of sodic sulphate is used. No peroxide is formed in a solution of potassic nitrate; the liquid gets filled with a flocculent light brown precipitate of argentic oxide. In a solution of potassic ferrocyanide the silver becomes covered with a white film of amorphous argentic ferrocyanide, and in one of potassic dichromate with a reddish black film of crystallised argentic chromate.—(*Göttinger Nachr.*, 1868, 139).

Menaphtoxylic Acid and its Derivatives.—A. W. Hofmann. The reaction by which the author obtained benzoic acid from aniline and toluilic acid from toluidine he has made use of for the production of menaphtoxylic acid (naphtalene-carboxylic acid) from naphtalene. (*Ann. Chem. Pharm.*, cxlii., 121.) On distilling the primary naphtylaminic oxalate a distillate rich in naphtylformamide is obtained;—

$$\left.\begin{matrix}C_2\Theta_2\\H_2\end{matrix}\right\}\Theta_2 + \left.\begin{matrix}C_{10}H_7\\H_2\end{matrix}\right\}N = \left.\begin{matrix}CH\Theta\\C_{10}H_7\\H\end{matrix}\right\}N + H_2\Theta + C\Theta_2$$

and on treating this product with chlorhydric acid, and distilling in a current of steam, the nitrile of naphtalene-carboxylic acid is carried over. This nitrile, after re-crystallisation from alcohol, fuses at 33·5° C., and boils at 296·5°. It combines with ammonic sulphhydrate, forming the crystalline compound, $C_{11}H_9NS$.

Naphtalene-carboxylic amide, $C_{10}H_7.C\Theta.NH_2$, is obtained by dissolving the nitrile in alcoholic sodic hydrate and precipitating with water. It fuses at 204°. Naphtalene-carboxylic acid, $C_{10}H_7.C\Theta.\Theta H$, is formed by a prolonged treatment of the nitrile or amide with aqueous sodic hydrate, and separated by precipitation with chlorhydric acid It fuses at 160°, is sparingly soluble in water, more readily in hot alcohol. The chloride, $C_{10}H_7\Theta Cl$, which is obtained by mixing four parts of the amide with five of phosphoric chloride, gives with ammonia the amide of the acid; with aniline the anilid, $C_{11}H_7\Theta.C_6H_5.HN$; with naphtylamine naphtalene-carboxylnaphtylamide—

$$C_{11}H_7\Theta.C_{10}H_7.NH.$$

The anhydride of naphtalene-carboxylic acid, $(C_{11}H_7\Theta)_2\Theta$, is obtained by heating the chloride or calcic salt to 140°. It fuses at 145°, is insoluble in water, sparingly soluble in alcohol, readily in ether and in benzol.

The author concludes by remarking that the acid here described is most probably identical with the naphtalene-carboxylic acid of V. Merz (Chemical News, No. 460, page 151).—(*Deutsch. Chem. Ges.*, Berlin, 1868, 38).

Xenol.—E. Wroblevsky. To convert xylol into xenol (oxyxylol), $C_6H_3(CH_3)_2(H\Theta)$, a solution of potassic xylolsulphate is mixed with potassic hydrate, the solution evaporated to dryness, and the dry mass heated to 300° C. for one hour. Water is then added with a little chlorhydric acid and the xenol distilled off in current of steam. Xenol thus prepared is a liquid, boils at 214·2° (corr.), is sparingly soluble in water, readily in alcohol and ether. It is readily acted upon by bromine, being converted into tribromxenol, $C_8H_7Br_3\Theta$, a yellow crystalline body fusing at 141°, insoluble in water, soluble in alcohol. The action of sodium and carbonic anhydride upon xenol gives rise to the formation of xyletinic acid, $C_9H_{10}\Theta_3$. This acid when re-crystallised from hot water is obtained in white crystals which fuse at 155°. An aqueous solution is coloured violet on addition of ferric chloride. The composition of its baric salt is $(C_9H_9\Theta_3)_2Ba + H_2\Theta$. The properties of xyletinic acid distinguish it from phloretinic acid, and likewise from its two other isomers—tropaic and melilotic acid.—(*Zeitschr. Ch.*, N.F. iv., 232).

Chloracetic Acid.—N. Fazukowitsch. Chlorinated chloracetyle is most readily prepared by passing chlorine into chloracetyle containing iodine. Distillation of the raw material over copper renders it chemically pure; boiling point 106° C. On mixing chloracetylic chloride with an equivalent proportion of water, the whole is converted into chloracetic acid. By the action of chloracetylic chloride upon urea, the compound

$$CH_3(C_2H_2Cl\Theta)N_2\Theta,$$

is formed. The chloracetic urea is acted upon by potassic cyanide, and amongst the products of this reaction the author expects to find Carbituric acid.—(*Ibid.*, N.F. iv., 234).

CORRESPONDENCE.

A QUESTION IN THERMOTICS.

To the Editor of the Chemical News.

Sir,—"Volta" will find that he has assumed, without proof, that the latent heat of steam is the same at 0° C. as it is at 100° C. This is not the case. According to Regnault's results, the latent heat of steam at 0° C. is 606·5, instead of 537. There is a further error in taking ·4805 for the specific heat of steam. The specific heat to be employed is the true specific heat—viz., that at constant volume. The specific heat of steam at constant volume, referred to that of an equal weight of water as unity, is 0·369. Using this number, we have by this second method of calculation for the total quantity of heat in 1 gr. of steam at 100° C., 36·9 + 606·5 = 643·4, a result sufficiently near to 637.

It is probable that the specific heat of steam between 0° C. and 100° C. is less than the specific heat at 100°.; and the number 0·369 was obtained by Regnault at temperatures above 100° C. It is obvious that if we possess a sufficiently accurate determination of the latent heat of steam at 0° C., this method will enable us to calculate the specific heat between 0° and 100° C. from that at 100° C. —I am, &c.,

W. Marshall Watts.

MISCELLANEOUS.

The New Parliament.—There is good reason to hope that Science will be well represented in the new Parliament, for some of our most eminent chemists and physicists are in the field. Amongst them we may mention Dr. J. H. Gladstone, F.R.S., who is working hard to secure a seat for the city of York; Dr. Lyon Playfair, F.R.S. and Dr. Richardson, F.R.S. are candidates for the University of Edinburgh; while Mr. J. Lowthian Bell is, we hear, aspiring to a seat for Berwick; Alfred Smee, F.R.S., for

Rochester; Sir John Lubbock, Bart., F.R.S., for West Kent; and Colonel Sykes, F.R.S., again a candidate for Aberdeen. We studiously avoid political and party questions in this journal, but we cordially wish these eminent candidates success, because the great question of technical education, which has been so freely discussed in our columns, is likely to receive the serious consideration of the reformed parliament, and the greater the number of scientific representatives, the more likely are we to have this momentous subject brought to a satisfactory issue.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Archives des Sciences.

July 15, 1868.

W. Siemens and Halske, "An Improved Apparatus for Measuring the Flow of Alcoholic Liquids and for Indicating the Quantity of Absolute Alcohol contained therein."

Bulletin de la Société Industrielle de Mulhouse.

April, 1868.

J. Kolb, "Researches on Chloride of Lime, serving as an Introduction to a Memoir on the Use of that Substance for Bleaching Fabrics."

May, 1868.

A. Scheurer-Kestner, "Researches on the Combustion of Coal." Weber, "Report on E. Burnat's Building Boxes for Birds." Sageblien, "On a new Water Wheel." J. Siegfried, "Report on J. Dollfus' Paper on the Results of the Cultivation of Cotton in Algeria." A. Scheurer-Kestner, "Historical Note on the Methods employed for obtaining Sulphur from Soda Waste." "Résumé of the Author's Memoir on the Combustion of Coal." "Memoir on the Composition of the Gaseous Products of Steam Boiler Furnaces." J. Roth, "On the Use of the Yolk of Eggs for the Preparation of Chocolate and for the Manufacture of an Article of Food."

Supplement.

May, 1868.

M. Paraf-Javal, "Note on a Method of Facilitating the Process of Printing Calico with Aniline Black." C. F. A. G. Weise, "An Improved Dye Beck." F. Dufourc, "On "Nimriff" and "Eiram," Two New Colouring Matters from Algeria." Coupier, "On the Preparation of Aniline and Toluidine Red without the Use of Arsenic Acid." H. Kœchlin, "On the Colouring Matter extracted from Soga Bark."

June, 1868.

C. Dollfus-Galline, "On M. Paraf-Javal's Method of Facilitating the Process of Printing Calico with Aniline Black."

Comptes Rendus.

July 27, 1868.

Berthelot, "On the Transformation of Marsh Gas into more condensed Carbides." C. Loay, "A Method of Estimating Carbonic Acid in Bicarbonates and in Water." V. de Luynes, "On the Colouring Matters derived from Orcine."

August 3, 1868.

P. Desains, "Researches on the Obscure Calorific Rays of the Spectrum." Treves, "On the Development of Magnetism by Induction in Steel Bars." A. Bonteare, "On a Remarkable Case of the Transport of Metals by Atmospheric Electricity." Berthelot, "On the Hydrides of the Carbides of Hydrogen. Styrolene Series. Part I." A. Descamps, "On the Double Cyanides analogous to the Ferrocyanides and Ferricyanides." J. Lefort, "Some new Observations on the Colouring Matters of Persian Berries."

August 10, 1868.

Chevreul, "Report to the Minister of Public Instruction on the Course of Lectures on Applied Organic Chemistry delivered at the Museum of Natural History during the year 1867." A. Secchi, "On Stellar Spectra." Toselli, "An Improved Method of Manufacturing Large Blocks of Ice." Berthelot, "On the Hydrides of the Carbides of Hydrogen. Styrolene Series. Part II. (Conclusion)." A. Rosenstiehl, "On the Detection of Aniline, Pseudo-toluidine, and Toluidine." Mehay, "On the Condition of Salts in Solutions."

Annalen der Chemie und Pharmacie.

August, 1868.

C. Stalmann, "Researches on some Salts of Natural and Artificial Valeric Acid." M. Theilkuhl, "On Methintrisulphonic Acid, the First Term of a new Series of Acids." F. Ilse, "On Amylenedisulphinic Acid." T. Wilm and G. Wischin, "Experiments with Phosgene and Phosgenic Ether." "On the Action of Aniline on Chloro-carbonic Ether." R. Otto and G. Möries, "On Mercury-Naphthyl, and on some Derivatives of Naphthaline." R. Otto, "Note on the Reduction of Hyposulphuric Acid to Sulphurous Acid by Nascent Hydrogen." W. Heintz, "On the Constitution of Diglycolic Acid, and on a new Method of forming Diglycolic Ether." C. Schorlemmer, "Contributions to the Knowledge of the Hydrocarbons of the Series C_nH_{2n+2}." "On the Caprylic Alcohol obtained from Castor Oil." O. Hesse, "Contributions to the Chemistry of the Quinine Bases." E. von Gorup-Besanez, "On the Synthesis of Oil of Guaiacum Resin."

Journal für Praktische Chemie.

July, 1868.

J. L. W. Thudichum, "Chemical Researches on the Colouring Matters of Urine: On Uromelanine, a Decomposition-Product of Urochrome." E. Reichardt, "On Mercurialine, an Alkaloid obtained from *Mercurialis annua*." F. von Kobell, "On the Detection of Nickel and Cobalt in Ores, and on a Specimen of Chathamite from Andreasberg in the Hartz."

Bulletin de la Société Chimique de Paris.

August, 1868.

B. Tollens and R. Weber, "On Formiate of Allyl." T. L. Phipson, "On the Analysis of a Biliary Calculus, and on the Preparation of Biliverdine." Chevalet, "On the Estimation of Carbonates in Aqueous Solutions." P. P. Dehérain, "Experimental Researches on the Use of Potash Salts in Agriculture made during the year 1867." A. Scheurer-Kestner, "Researches on the Combustion of Coal." A. Scheurer-Kestner and C. Meunier, "Analysis of the Gases produced during the Combustion of Coal from Saarbruck." E. Bourgoin, "On the Identity of Dimethyl with Hydride of Ethylene. H. Baubigny, "On the Preparation of Campholic Acid."

NOTES AND QUERIES.

Lubricating Oils.—A correspondent would be glad to know of the best work on the manufacture or refining of lubricating oils.

Cement Required.—A cement or glue to fix an india-rubber washer to cast iron. Cement or glue must stand boiling water and superheated steam.—A. W. Wilson.

Vegetable Fibre.—A correspondent is particularly anxious to procure samples of a vegetable fibre of great toughness and of good length. Can any reader forward specimens?—W. W. Roberts.

Salt of Manganese.—What formula does Rammelsberg ascribe to the red salt of manganese, cyanogen, and potassium, mentioned in the Chemical News, vol. xv., page 201, and does any account of these researches exist in English.—Mx.

Phosphoric Acid.—A good method of separating phosphoric acid from bases consists in dissolving the substance to be analysed in a small quantity of nitric acid, and adding to the solution, first nitrate of silver, then carbonate of silver, and well shaking. All the phosphoric acid then combines with the oxide of silver and is precipitated, whilst the bases remain in solution and may be freed from the excess of silver by means of hydrochloric acid.—F. Wöhler.

Fire-Proof Dresses.—Some years ago, at the request of the Queen, Dr. Graham, the present Master of the Mint, caused a series of experiments to be instituted by Dr. Versmann, the result of which led to the regular use of a tungstate of soda in the Royal laundry to render ladies' wearing apparel fire-proof. Dr. Versmann published a pamphlet on this subject, giving full instructions as to the use and application of the above-named article (the tungstate of soda), and it is likely that your correspondent, Philip Sankey, can obtain all the particulars from Dr. Versmann. Tungstate of soda, fit for this purpose, is to be had cheaply enough, and its use neither affects the fabrics, nor injures the beauty or colours thereof.—Dr. A. A.

TO CORRESPONDENTS.

J. E. Wright.—The *Comptes Rendus* are published weekly by Gauthier-Villars, Quai des Augustins, 55, Paris.

Chemicus.—Chlorhydric acid is the same as hydrochloric acid. Oleic acid can be purchased at an operative chemist's. Naphthalene yellow, known also as Manchester yellow, is made by Roberts, Dale, and Co., Manchester.

Robinson, Brothers.—Many attempts were made to ascertain the relation between the light emitted by the parliamentary standard sperm candle and that given by the new standard lamp described in No. 450 of the Chemical News; but the variations in the candle light were found to be so great under different circumstances that no satisfactory data could be obtained, and it was therefore thought better give ot no results at all, but to leave this comparison to persons who were in the daily habit of using the standard candle and might be supposed to know the best way to get a uniform light from it.

Communications have been received from Messrs. Brooke, Simpson, and Spiller; Dr. Adriani; Dr. J. H. Gladstone, F.R.S.; D. Forbes, F.R.S.; Dr. F. C. Calvert, F.C.S.; Messrs. Roberts, Dale, and Co.; Dr. R. A. Smith, F.R.S.; J. E. Wright; Robinson, Brothers; T. J. Blunt; E. Bird; W. L. Lewis; C. C. Watkins; J. Kenyon; J. Y. Buchanan (with enclosure); Maclachlan and Stewart (with enclosure); Ludwig Mond (with enclosure); R. Warington (with enclosure); G. F. Rodwell Dr. T. Wood F. Tibbs; S. W. Rich; and Dr. Watts.

THE CHEMICAL NEWS.

Vol. XVIII. No. 464.

ON SOME POINTS IN CHEMICAL GEOLOGY.

By DAVID FORBES, F.R.S., &c.

IV.

The Constitution of the Interior of the Earth.—Although we are naturally precluded from directly investigating more than the mere external contour of the globe which we inhabit, the nature of its interior must ever be of the highest interest and importance in chemical geology, since whatever be the hypothesis as to its composition and character which is accepted by the chemist or geologist, it cannot fail to influence greatly the general tenour of his reasonings as a whole.

The long and widely received doctrine, that the interior of the earth is still in a state of molten liquidity, is a deduction from the numerous data collected by an extended study of the various terrestrial phenomena, which form the subject of geological inquiry.

The direct evidence afforded by the frequent and great outbursts of molten lava, which in every quarter of our globe are met with, breaking through the surface of the land and disturbing the bottom of the sea, and which moreover present in all parts of the world, however distant from one another, the same general features of mineral and chemical composition, could not but lead to the very natural inference that these eruptions must proceed from some vast internal accumulation of molten matter, situated at comparatively no very great distance below the surface.

Such inquiries, therefore, led to the hypothesis that the earth is in reality a molten fluid mass enclosed within or bounded by a relatively thin crust or shell which forms its present surface; whilst astronomical and geodetical investigations into the true figure of the earth, further pointed out the probability that this state of things had originated in the external cooling of a sphere of molten matter in rapid revolution around its axis.

The late Professor Hopkins, of Cambridge, was the first who brought forward any serious objection against this all but universally received hypothesis, declaring in a series of memoirs published in the transactions of several learned societies, that by employing a line of reasoning founded on mathematics and astronomy, he had proved this hypothesis to be inconsistent with the known phenomena of the precession and nutation, which, according to him, would require that the external crust of the earth should possess a thickness of not less than 800 to 1,000 miles.

This system of reasoning was subsequently followed by Archdeacon Pratt in his work on the figure of the earth (edition of 1860) and still later by Professor Thomson, of Glasgow, in a memoir on the rigidity of the earth (*Philosophical Transactions*, 1863), where the conclusion arrived at is that the earth if not solid to the core must be nearly so, the summing up (page 573) being, "That no continuous liquid vesicle at all approaching to the dimensions of a spheroid 6,000 miles in diameter, can possibly exist in the earth's interior without rendering the phenomena of precession and nutation very sensibly different from what they are."

This, if it may be so called, mathematico-astronomical deduction, notwithstanding its being so diametrically opposed to the previously received hypothesis, which was professedly the conclusion arrived at from a prolonged study of terrestrial phenomena, does not appear to have been disputed or even questioned as to the correctness of either its premises or arguments, and seems to have been at once accepted by a class of chemists and geologists, who either unwilling or incompetent to take such problems into mature consideration, are always ready to adapt their opinions, like their garments, to the latest fashions.

The natural sciences, however, are assuming each day a more and more exact character, and their true and sure advancement demands that no doctrine whatsoever shall be taken for granted, even when put forward, as in this case, by the most eminent authorities, until the evidence for and against it has been thoroughly scrutinised and the balance shown to be in its favour.

The conclusion as to the entire solidity of the earth put forward by these distinguished mathematicians and astronomers, although, as before said, accepted by many, has, however, its opponents, and amongst them several very eminent men of science, who still hold to the old hypothesis of its internal fluidity.

Thus, in the discussion on underground temperature at the recent meeting of the British Association at Norwich, Mr. Sartorius Von Waltershausen, so well known in connection with his researches on volcanic phenomena, declared that from his recent calculations he believed that the thickness of the earth's crust was only 14 geographical miles, and gave as his further opinion that at the time of the first formation of the seas on the face of the globe it did not exceed 50 metres.

The attempt to decide such scientific problems merely by reference to authorities, or in other words to bring in the *argumentum ad hominem*, is a deplorable mistake; such questions must be decided upon their own intrinsic merits, and if the explanation or hypothesis is true, no number of distinguished men are needed in its support; whilst, if false, their names may possibly retard, but cannot prevent its ultimate rejection.

The data upon which the hypothesis of the internal fluidity of the earth is based are so numerous, and at the same time so thoroughly tangible and self-evident, that it would appear unjust to throw this theory overboard at once, merely upon the strength of a single argument advanced against it from the regions of astronomy; at least, not until this objection had been thoroughly examined into and proved correct.

Such a scrutiny, however, was beyond the powers of the mere chemist or geologist, since it entailed a more than ordinary knowledge of mathematics and astronomy seldom likely to be at their command, and they therefore cannot but feel highly gratified to find that the question has at last been taken up and thoroughly investigated, both theoretically and experimentally, by so competent an authority as the author of the *Mécanique Rationnelle*, M. Delaunay, a man of science equally eminent as mathematician and astronomer.

In a memoir,* read before the French Academy, the 13th July last, M. Delaunay has taken the results obtained by Professor Hopkins, Archdeacon Pratt, and Professor Thomson, into mature and minute consideration, and the conclusions he has arrived at are—that the objections which have been brought forward and supported by these eminent mathematicians and astronomers, against the hypothesis of the internal fluidity of the terrestrial globe, are not founded on any true basis whatsoever, or to use his own words "ne repose sur aucun fondement réel," and further that the phenomena of precession and nutation cannot furnish any data for determining the thickness of the earth's crust:—"la considération des phénomènes de la précession et de la nutation ne peut fournir aucune donnée sur le plus ou moins d'epaisseur de la croûte solide du globe."

In arriving at these conclusions, M. Delaunay fully admits the universally received facts and explanations of the phenomena of precession and nutation, and does not even object to the mathematical part of the investigation[*] employed by his opponents, but confines himself to demonstrating experimentally, as well as by argument, that the premises from which they started in their inquiry, and upon which their deductions must naturally be based, were in themselves essentially unsound and untenable.

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* A translation of which will be found in the *Geological Magazine* of November, 1868.

These premises consisted in taking for granted that the behaviour of an entirely solid globe, in its relations to the phenomena of the precession and nutation, would be materially different from what that of a globe would be in the case it were merely composed of a solid external crust or shell filled with fluid matter.

Mr. Delaunay then points out that this view has been adopted upon the supposition that liquids are endowed with the property of *absolute fluidity*; in which case, if a globe filled with such a liquid was suddenly set in rotation around its axis, the external shell should alone revolve, without at all carrying the liquid along with it, which ought to retain its pristine immobility.

No one except a true mathematician could form in his mind such an abstract idea of a liquid, and whilst admitting its *absolute liquidity*, forget that, however feeble it may be, still that no liquid whatsoever is absolutely destitute of *viscidity or viscosity*, a fact which easily explains why the liquid interior of the globe would be carried round along with the solid shell which enclosed it, the whole revolving together just as if the liquid had been congealed, and along with its retaining envelope actually formed one entirely solid body.

Even if it be advanced, that at any particular epoch a difference might have existed between the rate of movement of the crust and that of the liquid interior, the resulting friction must gradually have obliterated this difference and brought about an absolute conformity between the motion of the solid and liquid parts.

In order fully to appreciate the clear and sound line of reasoning employed by Mr. Delaunay in solving this problem, his original memoir must be consulted; and from this it will be seen, that, he has not been content merely with having proved his points by arguments alone, but that by the construction of an experimental model has fully removed any doubts which might have subsequently suggested themselves as likely to affect the validity of his conclusions. The objections brought forward by Professors Hopkins and Thomson, as well as by Archdeacon Pratt, may be therefore considered as explained away, and until further proof is brought forward to the contrary, we may still regard the hypothesis of the internal fluidity of the earth as representing the result of geological enquiry upon this subject posted up to date.

Solidification of the Terrestrial Globe.—Whatever may be the difference of opinion as to the nature and composition of the interior of the earth, there appears, however, to be almost perfect accordance amongst men of science in general as to the hypothesis that the terrestrial globe was at one period in a state of molten liquidity; and the more recent researches of astronomers on the nebulæ and other celestial bodies, in which the spectroscope has been of incalculable assistance, further tends to support the nebulous theory of its origin, which explains the production of such a molten sphere by the condensation of previously gasiform matter.

In considering the effects of the cooling, and the consequent solidification of this molten globe, opinions have been somewhat divided, the majority contending that, like most bodies with which we are acquainted, it would consolidate first on its exterior; others imagine that, owing to the enormous pressure to which its central portion must be subjected, that the solidification would have commenced, first at the centre, and then gradually proceeded outwards to the external surface, which was the last to become solid; whilst others again, like the late Professor Hopkins, contend that the solidification would commence at once both at the centre and surface, so that at the same time there would be a central solid nucleus separated from an external crust by an intermediate zone of still fluid matter.

Professor Hopkins, who, as before observed, had arrived at the conclusion that the earth must be in major part solid, and who fully acknowledged the difficulty of explaining the sources from which the molten lavas accompanying volcanic outbreaks proceeded, appears to have been the more disposed to adopt this last hypothesis, from imagining that such a process of solidification would be likely to leave reservoirs of still liquid matter situated between the external crust and the internal solid nucleus from which he imagined volcanic matters are ejected.

This view of the process of solidification, simultaneous both from centre and surface, seems to be corroborated by the results of experiments made upon the fusing points of bodies under pressure (although in the present state of our knowledge it is unwise to place too much dependance upon these experiments), whilst it seems quite impossible to imagine that the cooling action of the surrounding atmosphere could fail to cause the formation of a solid external crust at the same time.

The only objection which has been brought forward against the probability of a consolidation at the surface is that the solid crust so formed, would be immediately broken up by its own contraction in solidifying, and being heavier than the fluid from which it had congealed, would sink down into it. This objection, however, is very easily encountered, especially when it is remembered that such a crust would solidify, as well as for a long period remain, at a very high temperature, which would quite prevent its being likely to break up and fly to pieces as if it were to be cooled suddenly to a greatly lower temperature; for this reason also such a crust would form a double-dome or spherical cover to the earth, the particles of which would mutually support one another.

Experiments have further proved, that in the cases of at least several substances which contract in cooling, these bodies, when in the hot expanded condition, are really lighter than when molten, as in the case of Bessemer steel, brought under my notice by Mr. Hackney, who found that the hot steel lumps floated about in the melted bath of the same steel; since then, however, I have been able, through the kindness of Dr. Lloyd of Birmingham, to prove that this is also the case with silicates such as glass, for when Dr. Lloyd, at my request quietly laid solid discs of glass 9½ inches in diameter and 1 inch thick, which weighed 7½ lbs. each, upon the surface of a large pot full of the same melted glass at founding heat, they only partially sunk into and floated on the surface of the metal, until by degrees, after a very considerable time, they became ultimately absorbed in the vastly greater body of the melted metal on which they rested. Another circumstance must also be taken into consideration—viz., the actual condition of aggregation of a solidified crust formed on the top of an enormous body of silicates in fusion. Its surface would no doubt resemble the scoriacious surface of the crater of a volcano full of boiling lava, or the vesicular froth or light scoriacious mass which swims on the more dense slags in metallurgical operations; and this porous state of aggregation, upon the cooling of the globe to so low a temperature that water could rest upon its surface, would most materially contribute to its rapid disaggregation and breaking up, by the action of the water and carbonic acid contained in the primeval atmosphere of the globe.

Contraction which occurs upon the Consolidation and Cooling of Fused Silicates.—This is a point of considerable importance in inquiries of this nature, and whilst it is admitted that most, if not all, silicates do contract in passing from the heated to the cold state, or in other words that the solid cold rock occupies less bulk than it does when molten, opinions differ considerably as to the amount of such contraction in various rocks, principally for the reason that great difficulties are encountered in determining experimentally the actual difference in volume between the molten and solid substance operated upon.

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[*] Professor Thomson, (*Philosophical Transactions*, 1863, p. 573), whilst he agrees with Mr. Hopkins in the force of his arguments, appears to differ with him on this head, remarking "Although the mathematical part of the investigation might be objected to."

Bischof has taken this subject into very detailed consideration, and as the result of a long series of experimental determinations gave (Leonhardt and Bronn's *Jahrbuch*, 1841) the following summary:—

	Volume in fluid state.		Volume in crystalline state.
Basalt	1	=	0·8960
Trachyte	1	=	0·8187
Granite	1	=	0·7481

	Volume in glassy state.		Volume in crystalline state.
Basalt	1	=	0·9298
Trachyte	1	=	0·9214
Granite	1	=	0·8420

By a simple calculation these figures may be placed in a more convenient form, as follows:—

	Volumes in the igneous or molten condition.		Volumes in the vitreous or colloid condition.		Volumes in the stony or crystalline condition.
Basalt	1000	=	963	=	896
Trachyte	1000	=	888	=	818
Granite	1000	=	888	=	748

From the above figures it will be seen that, according to Professor Bischof, the two rocks, granite and basalt, which form the extremes of the petrological series of silicated crystalline rocks, differ very greatly from one another in the amount of contraction which they respectively undergo in passing from the fluid to the solid state, since, according to him, granites suffer a diminution of above 25 per cent in volume, whilst basalts contract somewhat more than ten per cent when passing from the molten to the stony condition—results which lead to the inference that the contraction becomes greater in proportion as the rocks are more highly silicated.

According to these results, also, a mass of molten rock in the process of cooling, first contracts considerably when it passes into the glassy or colloidal state, and then again contracts in a still greater degree before it attains the stony or crystalline condition.

This latter deduction I have experimentally verified in the case of several rocks, and amongst others that of the well known so-called Rowley Rag stone of Staffordshire, which is a doleritic rock of the post-Carboniferous, but anti-Permian geological age; the composition of this basaltic rock, according to Henry, is:—

Silica	49·86
Alumina	12·75
Lime	8·71
Magnesia	4·39
Protoxide of iron	11·38
Sesquioxide of iron	3·36
Potash	0·57
Soda	5·25
Titanic acid	1·33
Phosphoric acid	0·58
Water	2·56
	100·74

Mineralogically, it is composed chiefly of a soda-lime triclinic felspar, most probably Labradorite with augite, along with titanoferrite, and a green hydrous silicate, probably seladonite; it also occasionally contains traces of apatite, zeolites, &c.

The specific gravity of the Rowley Rag was found to be 2·84, which was the average of numerous determinations made on specimens of the perfectly unaltered rock, each from 2,000 to 6,000 grains in weight.

After fusion in a reverberatory furnace, and being allowed to cool under different conditions, the resulting products were found to possess respectively the following densities:—

1. Perfect black glass	(sp. gr.)	2·67
2. Less perfect ditto	„	2·71
3. Black glass showing a tendency to devitrification	„	2·73
4. Black glass enclosing devitrified spheres	„	2·75
5. Completely devitrified crystalline product	„	2·84
The original Rowley rag-stone being also	„	2·84

The above numbers are reliable, having in all cases been verified by several determinations on different fragments varying from 1,200 to 6,500 grains in weight.

These experiments were made in 1855, at the works erected by Messrs. Chance near Birmingham for the manufacture of Rowley Rag glass and devitrified castings, or so-called artificial stone, and as these works are now no longer in existence, I have since regretted that the opportunity was not then taken advantage of, in order to determine decisively the contraction actually sustained by this basaltic rock, when passing from the liquid into the solid or stony condition; for I retain the distinct impression that it appeared then to be very much less than it should be, if the results of Bischof's experiments above cited were correct.

As the devitrified castings of Rowley Rag manufactured by Messrs. Chance were often of large dimensions, frequently blocks several feet in length and weighing upwards of half a ton, it occurred to me that an estimate of the relative amount of contraction would be obtained if the dimensions of the wooden pattern used in forming the mould were compared with the actual measurements of the devitrified block cast in this same mould. I therefore wrote to Messrs. Chance, begging them to assist me by taking the exact measurements of several of their largest castings, as well as of the wooden patterns from which they had been moulded. This they at once did with their usual kindness and desire to assist scientific investigation, and the result was soon after communicated to me by Mr. Alexander Chance in the following words: "Our Rowley Rag was always cast in red-hot sand moulds, so as to allow of the slowness of cooling necessary for the devitrification of the melted mass. We find that the stone thus produced is of precisely the same dimensions as the wooden pattern, showing no contraction whatever." Since, however, the moulds in which these castings were made were previously heated, no conclusive result can be deduced from the above facts beyond the inference that it is extremely improbable that any contraction as large as 10 per cent (as maintained by Bischof for basalt) could have taken place.

In 1847, when at the Eidsfoss Iron Works in Norway, I attempted to throw some light upon this point by some similar experiments on the slags produced by the blast furnace there. These slags were extremely acid, and in round numbers their composition would approximate to—

Silica	60	per cent.
Alumina	15	„
Lime	17	„
Magnesia	2	„
Oxides of Iron and Manganese	1	„
Alkalies	5	„
	100	

The slags were allowed to flow into iron moulds 10 inches long by 6 inches deep and wide, also containing 360 cubic inches, a heavy iron top-plate being dropped upon them when overflowing so as to ensure their being filled completely and evenly. When cold these blocks differed so extremely little in external dimensions from the actual size of the mould in which they had been formed, that their contents were found to be in no case less than from 350 to 355 cubic inches, equal to a contraction of about from 1½ to 3 per cent only, instead of being more than three times that amount if we calculate according to the amount of silica contained in them, and the co-efficients of contraction by Professor Bischof.

In 1849 and 1850 numerous experiments were made by me, conducted in a precisely similar manner (and in the identical same moulds used at Eidsfoss) at the Espedal smelting works also in Norway. In this case the slags were of a very different nature, being of two distinct kinds, both of which were more basic and contained more oxide of iron than the blast furnace slags; the composition of these slags being approximately—

	I.	II.
Silica	42	30
Alumina	12	4
Lime	5	2
Magnesia..	9	1
Protoxide of Iron (with some Fe_2O_3).. ..	27	59
Protoxide of Manganese, Copper and Nickel	1	1
Alkalies	4	3
	100	100

The results of these experiments did not materially differ from those obtained in the case of the Eidsfoss blast furnace slags, and in 1856, in Birmingham, I likewise obtained very similar results when employing slags produced in the smelting of silver and nickel ores, in which experiments the iron mould was made large enough to contain a block weighing about 400 pounds. Further observations on the very basic slags of the Staffordshire blast furnaces and puddling furnaces poured into sand moulds also led to similar conclusions.

Such experiments add to our information on the subject under consideration, and point out the great probability that the actual contraction experienced by silicates is much less than generally estimated, still it must be admitted that they do not provide a certain means of determining the actual amount of contraction with any accuracy, for with the exception of the devitrified Rowley Rag[*] masses cast in hot moulds, the blocks of slags on breaking up were never found to be altogether free from cavities due either to the enclosure of gases or possibly also to contraction.

In order to overcome this difficulty, I proposed making similar experiments with silicates, which upon fusion would like ordinary glass be so transparent that any such cavities could at once be detected.

The fact of glass being so much more acid a silicate, and consequently, as the following analysis will show, so much more allied to granite, makes it still more adapted for this purpose by permitting of a wider margin for experimental errors; molten granite, according to Bischof, contracting more than 11 per cent in volume when brought to the glassy state or above 25 per cent when in the stony or crystalline condition.

	Plate Glass (Dumas).	Dublin Granite Haughton.
Silica	73·83	73·00
Alumina	3·50	13·64
Lime	5·60	0·11
Alkalies	17·55	7·74
Other bases	traces	5·48
	99·48	99·97

If any such amount of contraction took place in the case of glass which is manufactured on so vast a scale, it certainly would not have escaped the attention of the manufacturer, nor would it be difficult to obtain trustworthy evidence on this subject. On inquiry, however, they informed me that although there was a decided contraction both in blown as well as cast glass, still that it was extremely minute, and in the case of cast glass, only just sufficient to cause the glass to detach itself from the moulds. Messrs. Chance also confirmed this, stating that they believed that no perceptible contraction takes place when glass is cast and allowed to cool, and Dr. Lloyd of the Park Glass Works, at Birmingham, kindly offered to take the opportunity afforded by making a considerable number of solid large decklights for the navy weighing upwards of 40 lbs. each, to determine the amount of contraction with more precision; this, he informs me in a later communication, amounted to 1-16th inch in the length of 17 inches, equal to 1-272nd part linear, which would amount to only 1¼ per cent in volume.

The conclusion I would now draw from the consideration of the results obtained in this experimental inquiry, is that the amount of contraction which silicated rocks undergo in passing from the molten to the solid and cold state, must be very much less than usually taken for granted, and that in consequence of this, the effects due to such contraction, when considered in relation to certain geological phenomena, have been much overestimated.

It now remains but to attempt an explanation of the reasons why the results obtained by me differ so very much from those made public by Professor Bischof.

In the first place, the employment of comparatively large masses cannot but greatly tend to diminish the chances of error in such experiments, Bischof's experiments having been made in crucibles. Next if we turn to the detailed account of these experiments in Leonhardt and Bronn's *Jahrbuch* for 1843, pp. 1—50, it will be perceived that he melted down portions of the rocks in Hessian crucibles, the internal capacity of which was determined before and after the operation, by filling up with mercury, and by a somewhat complicated calculation the results are converted into the expression of the contraction: to any one acquainted with furnace operations and the effect of heat upon crucibles, it would probably appear most surprising that results, having any pretensions to be exact, could possibly be obtained by so crude a *modus operandi.*

NOTE ON

FRANKLAND AND ARMSTRONG'S PROCESS FOR ESTIMATING THE NITROGEN OF NITRATES AND NITRITES IN POTABLE WATERS.

By SIDNEY W. RICH.

Frankland and Armstrong's process for the estimation of nitrogen existing as nitrates and nitrites in potable water appears to be inapplicable when the water contains much chloride of magnesium and little carbonate or free alkali.

In such a water hydrochloric acid would be evolved by evaporation, and in consequence of the absence of any other available base, would, partially or wholly, decompose the nitrates and nitrites existing in the water. Two experiments were tried to test this. No. 1.—0·2 gramme of nitrate of potassium, containing less than a milligramme of chlorine, dissolved in water and rendered slightly acid with hydrochloric acid, after repeated solution and evaporation, yielded ·0358 gramme Cl, indicating a loss of 50·9 per cent of the total nitrogen contained in the nitrate. No. 2.—250 c.c. of water, containing an excessive amount of solid residue and nitrite, after evaporation with a very small quantity of hydrochloric acid, was found to contain a trace only of nitrite. To avoid the above source of error it is necessary, either to ascertain that each sample of water contains a sufficient proportion of available carbonate or alkali, or else previously to make the requisite addition—say, of a weighed quantity of carbonate of sodium.

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[*] In order to account for the apparent non-contraction of these, Mr. Alfred Tribe, in a letter to the Chemical News, vol. xvii., p. 156, thinks that "cavities would also be found in them or on their surfaces." So far from any cavities being present which could explain the great amount of contraction which according to Bischof should take place, it was suprising to see, upon examining the many tons of castings broken up in the works, how extremely free they were from any cavities whatsoever, beyond the little so-called bubbles or air holes common to all ordinary metal castings, whilst their external surface was perfectly sharp and free from defects.

RECENT ANALYSIS
OF THE
"HOSPITAL MILD SULPHUR SPRING," OR "MAGNESIA WATER," ROYAL PUMP ROOM, HARROGATE.

By Dr. SHERIDAN MUSPRATT, M.D. (Hon.) Ph.D., F.R.S.E., &c.
Founder and Principal of the College of Chemistry, Liverpool.

As the "Magnesia Water" has of late become so popular with the faculty, I send you the following analysis of it, deeming the publication of a fresh one necessary, owing to the changes that have occurred from time to time in the constituents of most, if not all, of the other Spas. Subjoined is the tabulated composition inferred from the new results :—

	Grains in the Imperial Gallon.
Carbonate of Lime	18·476
Carbonate of Magnesia	12·799
Carbonate of Iron	trace
Carbonate of Manganese.. ..	faint trace
Chloride of Sodium	215·896
Chloride of Potassium	27·913
Chloride of Magnesium	1·792
Chloride of Barium	1·222
Chloride of Strontium	trace
Chloride of Lithium	faint trace
Sulphide of Sodium	0·707
Iodide of Sodium	faint trace
Bromide of Sodium	faint trace
Ammonia	faint trace
Silica, &c.	1·608
Total grains per gallon ..	280·413

	Cubic Inches of Gases in the Gallon of Water.
Carbonic Acid	11·50
Carbide of Hydrogen	5·47
Nitrogen	6·01
Oxygen	2·02
	25·00

The temperature of this spring is 44·50, and its specific gravity 1·00268; reaction, alkaline.

The water of this spring, since it was analysed by my friend and former collaborateur, Dr. Hofmann, fourteen years since (1854), has parted with its sulphate of lime, and I find replacing it chlorides of barium, strontium, and lithium. The last two were detected by the spectroscope, in a residue I sent lately to my dear departed friend, Dr. Herapath, of Bristol, whose premature removal other comrades, like myself, must sadly deplore. The amount of some of its active ingredients (chlorides of potassium, magnesium, &c.), is increased. Its constituents admirably adapt the water for cases of dyspepsia, certain forms of rheumatism, hepatic diseases, gout, &c. Patients can imbibe it at all hours, and its diuretic properties are most efficient.

College of Chemistry, Liverpool,
October, 1868.

NOTE ON SULPHUR PASTILLES.*

By WENTWORTH LASCELLES SCOTT.

The practice of burning sulphur for purposes of disinfection has been known and valued in most countries for many centuries, it being quite common in the time of Cleopatra; but every now and then attempts are made to invest the products of its combustion with superlative curative powers, the excitement consequent thereon generally dying away at the expiration of a longer or shorter time.

As one of these "volcanic cycles," as they might be called, is now apparently just commencing in this country, I have thought that a few words upon one section of this subject might not perhaps be wholly inappropriate.

It is not unreasonable to suppose, from its very remarkable antiseptic powers, that sulphurous acid should be serviceable in the treatment of what might be popularly designated fermentive diseases and affections, as it instantly arrests oxidation in almost every form. Of late, sulphurous acid has been recommended in three different forms—as vapour mixed with that of water for inhalation, in shape of liquid spray, and lastly again in the gaseous form, as produced by burning sulphur in air.

Without expressing any opinion here of its value in a purely medical point of view, my present object is simply to direct attention to the danger incurred in the use of the ordinary pastilles as commonly sold for disinfection.

I have examined a very large number of these, in this country and in Scotland, and find that, with few exceptions, they are made by simply "casting" sulphur into suitable moulds, the fluid element being mixed with a little finely divided charcoal, or black lead in some instances. They do not burn evenly, retaining their form, like the aromatic pastilles; but speedily fuse, and become little pools, as it were, of "liquid fire," difficult to extinguish, and extremely liable to inflame surrounding objects. As a rule, these "disinfecting pastilles" are placed in the hands of some servant, who simply applies a match to their point, and leaves them to "burn out;" thus, I hear from a correspondence with several insurance offices, have many "accidental fires" originated during the last few years, to the endangerment of life and property.

I have lately suggested a preferable mode of manufacture, which is now being very largely adopted, several hundredweights per month of these pastilles being made at this time.

Pure sulphur is reduced to a state of minute division, and intimately mixed with about 20 per cent of fresh dry plaster of Paris, some charcoal, and a mere trace of nitre; when mixed, a little stiff flour-paste is added, and the whole brought to a dough-like consistency under powerful stones. This dough, being formed in the requisite moulds into "pastilles," the latter are finally dried by steam-heat. Such pastilles burn slowly and evenly, not liquefying, and can be readily extinguished if required.

ELECTRIC ILLUMINATION.

Sundry Experiments Relative to the Production of Electric Light.

By F. P. Le ROUX.

(Continued from p. 183.)

Combination of the Incandescence of Earthy Oxides with that of the Charcoal Points between which the Voltaic Arc is Produced.—In applying electric light the method generally proposed is to direct it into a more or less limited region of space; all which escapes into the opposite region would be lost if it were not collected by reflectors more or less appropriate to the purpose. On the other hand, experience has proved that the voltaic arc is prone to irregular displacements, consequent upon inequalities in the cohesion of the charcoal, impurities contained in it, and above all the slightest agitation of the air. The most luminous portions of the charcoal electrodes being, as we have already remarked, the surfaces between which the arc arises, these surfaces are inclined sometimes in one direction and sometimes in another by reason of the displacement which the arc undergoes, the result being a considerable variation in the effect of light produced by the latter in any determinate region.

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* Read at the Norwich Meeting of the British Pharmaceutical Conference.

I believe that if there could be placed on the opposite side to that towards which the light was to be directed, and in proximity to the arc, some body capable of reflecting back in a luminous form the enormous number of radiations thrown upon it by the electrodes and the arc itself, these radiations would be more profitably utilised than by any other method, the arc being at the same time protected by a sort of screen, annulling in an almost hemispheric region all the above-mentioned disturbing causes.

The substance chosen for such a purpose should be at the same time a bad conductor of heat, and possessed of great powers of radiation, conditions fulfilled to a great extent by lime, magnesia, and earthy oxides in general. I first effected the experiment with cylinders of magnesia compressed according to the process of M. Caron, and manufactured for purposes of oxyhydric illumination. By placing the base of one of these cylinders, whose diameter is about 8 millimetres, at a short distance from the charcoal points of an electric lamp, in such a way that the magnesia may be, as it were, licked up by the voltaic arc, it will assume an incandescence equal to that of the most luminous portion of the charcoal. At the same time the light acquires remarkable constancy from the fixity of the arc, which may be drawn to greater length than in ordinary cases, because as the magnesia forms a screen and maintains the elevation of the temperature, the chances of the arc being broken are greatly diminished.

The magnesia may thus be kept in contact with the voltaic arc for more than an hour without sufficient consumption to cause any apparent change in the conditions of the experiment; its surface becomes hollow during the first few moments, but if the bar of this substance is kept fixed, the power of the arc abating at a very slight distance, it will no longer be consumed. Another kind of alteration will, however, ensue, the magnesia will imbibe the siliceous vapours emitted by the voltaic arc, and combine with them in a sort of glass, which, when cold, is of a pale greenish hue, and extremely hard. This fact is disadvantageous, inasmuch as it greatly diminishes the irradiating power of the magnesia, and renders the production of a commercial pure carbon in an appropriate condition for the purpose of electric illumination still more desirable.

The arrangement of a brilliant voltaic arc between two pencils of charcoal, and in the presence of magnesia or any other earthy oxide, would constitute one of the most beautiful sources of light possible to realise. It is probable that zirconia, whose remarkable properties with respect to the oxyhydric flame have been made known by M. Caron,[*] would be equally beneficial in the case of electric light; but at present I have had no opportunity of trying it. It may nevertheless be inferred that zirconia would, like magnesia, be quickly vitrified by the siliceous vapours of the charcoal, so that considering the high price of zirconia, it would be expensive to use unless the carbon were free from silica.

Decomposing Action of the Voltaic Arc on Earthy and Alkaline-Earthy Oxides.—When that splendid experiment which has since become familiar to us, though on a smaller scale, was performed by Davy with the pile of the London Royal Institution, he proved that the most refractory substances, such as magnesia, lime, and other oxides of the same kind, melted or even disappeared in this focus of intense heat.

Neither Davy nor any later experimentalists appear to have ascertained the nature of the alteration caused in the oxides by the action of the voltaic arc; the pursuit of other investigations has led me to a more attentive consideration of these phenomena, by which I have discovered that the oxides undergo a real decomposition. The advantages derived from the juxtaposition of a cylinder of magnesia to the charcoal points, for providing electric light, have been already alluded to; it may be added that lime or strontia will do equally well. If the cylinder of either of these substances be fixed, a slight cavity instantly forms at its base, and the conditions remain the same for an indefinite time, the arc continuing to play upon the body without inducing any modification but the vitrification caused by the siliceous vapours emitted by the impure charcoal. If, however, the cylinder of earthy matter be brought into actual contact with the charcoal points, and the pressure maintained by a slight spring, the aspect of things is changed.

If a pencil of lime or even plain chalk be used, the carbons will hollow out in it a sort of trench in which the heat is condensed as in a sort of reverberatory furnace, and the amount of light emitted is proportionally augmented. On examining the light with a piece of black glass it presents the appearance of an opaque luminous cloud in which the extreme ends of the charcoal are undistinguishable, their usually well marked brilliancy being lost in the mass of light, and there is a sensible evolution of whitish fumes. The spectroscope displays an intermittent spectrum filled with large and brilliant rays which are recognisable as those described by different authors as characteristic of calcium, but their number and intensity is greater and they are better defined. This is not suprising if the difference between the luminous intensity attainable by this process and by those hitherto employed be considered.[*] It would be doubtless possible by this method to obtain much new information respecting the spectra of metals, provided that only pure products were employed.

The employment of strontia gives analogous effects under the same conditions, the light assumes a characteristic red tinge, and the spectroscope displays the rays characteristic of strontium, thus presenting a simple means of enriching the electric light with red rays. It may be here remarked that the flame always contains a large proportion of white light, for if the metal be set free in some parts of the flame, in others it returns to the state of oxide, the incandescence of which always yields a white light.

After this it can no longer be doubted that earthy and alkaline-earthy oxides undergo decomposition by the voltaic arc; it now remains to be ascertained by virtue of what action it takes place. Is it an electro-chemical deposition? Does the oxide become a conductor by the elevation of temperature? Is it a reducing action of carbon vapour?[†] or lastly, is it, according to the theory of M. H. Sainte-Claire Deville, a result of elevation of temperature producing a separation of the elements in the same way as when oxide of mercury is heated? Do these three causes operate simultaneously? which is quite possible, or may one be wanting? I cannot say; but it appears to me that two may be suppressed: it is known to be possible to produce with solar light, concentrated in a focus of mirrors or lenses, a heat quite as powerful as that of the voltaic arc, and spectral analysis may be easily applied to these phenomena; to realise this idea, special conditions would be required not easy to improvise, but, nevertheless, I hope when possible to put it into effect.

Nothing can be easier than the practical application of the modes of improving the quality of electric light. Arrange in the horizontal plane which passes between the charcoal points a tube formed like a cylinder, from 8 to 10 millimetres in diameter, containing the oxide to be employed; this is kept in constant contact with the charcoal by a weak spiral spring. Experience shows that the slight friction which ensues does not prevent the action of the apparatus which regulates the movement of the charcoal. It is possible, if the oxide employed be excessively impure, that the vitrified matter would cause the charcoals to adhere to it; this might, however, be easily avoided by causing the charcoal electrodes to rotate slowly upon their axes.

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[*] *Comptes Rendus*, vol. lxvi., p. 1050 (May, 1868).

[*] The spark from the batteries doubtless possesses a higher temperature than that of the voltaic arc, but its duration is very short and its impression upon the organ of sight is an example of the brevity of its duration.

[†] Observations made by MM. H. Sainte-Claire Deville and Debray in the course of their examinations of the metals of the platinum series, show that on the contact of gas-coke and lime, heated in a flame of oxygen and hydrogen gas, phenomena of reduction occurred; thus, lime which has been subjected to these conditions, when plunged into water, disengages hydrogen gas, and will even burn in the liquid. (*Annales de Chimie et de Physique*, 3rd series, vol. lvi., p. 399, 1859).

ON FOOD.[*]

By DR. LETHEBY, M.A., M.B., &c.

(Continued from page 186.)

Functions of Different Foods.

And now, before I leave this part of the subject, it is right that I should say a few words respecting the functions of certain beverages (as tea, coffee, and fermented liquors), which have been more or less in use in all ages, as if from an untaught physiological instinct. Vegetable infusions, containing the same active principles—viz., astringent matter, volatile oil, and a crystallisable body rich in nitrogen, have been resorted to for some undefined purpose by the natives of every climate; indeed, to use the words of Mr. Johnston, "the practice has prevailed equally in tropical and in arctic regions. In Central America, the Indian of native blood, and the Creole of mixed European race indulge alike in their ancient chocolate. In Southern America the tea of Paraguay is an almost universal beverage. The native North American tribes have their Appalachian tea, their Oswega tea, their Labrador tea, and many others. From Florida to Georgia in the United States, and over all the West India Islands, the naturalised European races sip their favourite coffee; while over the Northern States of the Union, and in the British provinces, the tea of China is in daily and constant use.

"All Europe, too, has chosen its prevailing beverage; Spain and Italy delight in chocolate; France and Germany, and Sweden and Turkey, in coffee; Russia, Holland, and England, in tea—whilst poor Ireland makes its warm drink of the husks of the cocoa, the refuse of the chocolate mills of Italy and Spain.

"All Asia feels the same want, and in different ways has long gratified it. Coffee, indigenous in Arabia or the adjoining countries, has followed the banner of the prophet, wherever in Asia or Africa his false faith has triumphed. Tea, a native of China, has spread spontaneously over the hill country of the Himalayas, the table lands of Tartary and Thibet, and the plains of Siberia; has climbed the Altais, overspread all Russia, and is equally despotic in Moscow as in St. Petersburg. In Sumatra, the coffee-leaf yields the favourite tea of the dark-skinned population; while Central Africa boasts of the Abyssinian chaat as the indigenous warm drink of its Ethiopian people. Everywhere, in fact, un-intoxicating and non-narcotic beverages are in general use among tribes of every colour, beneath every sun, and in every condition of life. The custom, therefore, must meet some universal want of our nature, some physiological function which science has not yet explained; and, considering that these beverages contain essentially the same chemical compounds, it is remarkable that they should have been selected from the whole range of the vegetable kingdom." As Mr. Johnston truly observes, "What constitutional cravings common to us all have prompted to such singularly uniform results! Through how vast an amount of unrecorded individual experiences must these results have been arrived at!"

The principal constituents of these vegetable substances are—

1st. A volatile oil, on which their aroma depends, and which rarely amounts to one part in 150. 2nd. An astringent acid, of the nature of tannic acid in tea, and called caffeic acid in coffee, which give them their bitter styptic taste; it amounts to from 13 to 18 per cent in tea, and to about 5 per cent in coffee; and 3rd, a crystallised nitrogenous substance of an alkaline nature called theine or caffeine, and theobromine. The average amounts of this alkaloid in different vegetable substances, according to Dr. Stenhouse, is here recorded:—

	Theine or Caffeine per cent.
Guarana, or Brazilian cocoa, from *Guarana officinalis*	5·07
Good black tea	2·13
Black tea from Kemaon, E. I.	1·97
Dried Coffee Leaves	1·26
Maté, or Paraguay tea, from *Ilex Paraguayensis*	1·20
Various samples of coffee-beans ..	from 0·8 to 1·00

The physiological properties of this substance, and of its homologue, theobromine, are not clearly discoverable. Mülder states that they are not the agents concerned in the peculiar action of tea and coffee. Liebig, however, points to the fact that with the addition of oxygen and the elements of water they can yield taurine, which is the nitrogenised constituent of bile; and he asks whether they may not be concerned in the production of bile. Theine, he also states, is related to kreatinine—that remarkable compound, produced in the vital process, and occurring in the muscular system of animals; and to glycocol, which we may suppose to exist in gelatine coupled with another compound. In fact, according to him, there are no drinks which in their complexity, and in the nature of certain constituents have more resemblance to soup than tea or coffee; and it is very probable, he says, that the use of them as a part of food depends on the exciting and vivifying action which they have in common with soup. Reasoning in this way, it may be said that theine or caffeine, and theobromine, are closely related in their composition to nervous tissue, and that therefore they are suited for the repair and renovation of the exhausted brain. Experiments made by Lehmann, in 1854, with infusion of roasted coffee, and with caffeine, went to show that their chief influence on the human body was to retard the waste of tissues; that when, for example, an infusion of three-quarters of an ounce of roasted coffee was taken daily for a fortnight, the amount of urea and phosphoric acid excreted by the kidneys was less by one-third than when the same food was taken without the coffee. The empyreumatic oil was found to exert a stimulating action on the nervous system, and when taken in excess caused excitement and wakefulness. It also operated on the skin by producing a gentle perspiration, and it removed the sensation of hunger. The conclusion from these experiments was, that both tea and coffee exhilarate the nervous system, and, by lessening waste, enable the food to go further in its nutritive action; that with a given quantity of food more work could be performed when these beverages were taken than otherwise; and that in old, infirm persons, where the desire for tea is so strong, the waste and decay of the system was lessened. It operates, in fact, as a sort of lubricant of the animal system, and by oiling the machinery, enables it to work easier and longer.

The more recent experiments of Dr. Edward Smith are not exactly to the same purpose; for, in his opinion, tea promotes rather than checks the chemico-vital functions of the body, for directly after it is taken, the quantity of carbonic acid emitted from the lungs and the quantity of air inspired are increased; and there is greater depth and freedom of respiration. In this way, he thinks it promotes the transformation of starchy and fatty food; besides which, it increases the action of the skin, und by inducing perspiration lessens the heat of the body. Coffee, he says, has an opposite effect, for it lessens the action of the skin, and promotes that of the bowels; and its influence on the respiratory processes is somewhat less than that of tea.

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[*] The Cantor Lectures, delivered before the Society of Arts.

It is manifest from all this that we have yet to learn what are the special actions of these beverages; and why it is that they have been used in all times, and in all countries, as a means of supplying some natural want which science is unable to discover—that everywhere, the poor and the needy, the aged and the infirm, will make a sacrifice of even nutritious food for some such beverage as tea and coffee—that not less than 500,000,000 of the human race should make use of an infusion of tea; that more than 100,000,000 should drink coffee; about 50,000,000 cocoa; and not less than 10,000,000 of the inhabitants of Peru, Paraguay, and the Brazils should use an infusion of maté or guarana. In this country alone there is over 100,000,000 lbs. of tea consumed annually, and perhaps about half as much of coffee. All this looks like the influence of some deep-seated necessity which our philosophy is unable to fathom.

And with regard to the use of fermented liquors, there is the same universal indication of their serving a profound physiological purpose, and supplying a common want. It is no argument that, because these things have been abused they serve no purpose in man's economy. On the contrary, the fact of their use in all time, and that no saccharine liquid or juice of ripe fruit can be exposed to the air without spontaneous and almost immediate fermentation, are striking evidences of a useful purpose. They may not enter into the composition of tissues, but they may stimulate the energies of the living frame, and rouse them into increased activity. It is not merely the brick-work and marble, so to speak, of the human body, nor yet the concrete movements of the machine, that have to be sustained, for there are rarer forms of matter, and higher manifestations of force, concerned in man's existence; and his resort to such beverages as these may be for something more than the nourishment of the system, or even the mere raising of his spirit above the common concerns of this work-o'-day world.

That alcohol stimulates the action of the nervous system there is no doubt, and it is equally certain that it increases the respiratory changes. Dr. Edward Smith is of opinion that it also lessens the action of the muscles which are subject to volition, and increases, in a certain degree, the action of those which are independent of it, as the heart and respiratory muscles. He finds, too, that it diminishes the functions of the skin, and by thus lessening the waste of animal heat, it has a conservative tendency. The effects of alcohol are, however, much modified by the substances with which it is associated in different alcoholic liquids—beers and ale, for example, act on the respiratory functions by reason of the saccharine and nitrogenous matters they contain; wine also, as well as cider and perry, have a similar action, and in proportion to their saccharine and acid constituents; brandy and gin lessen the respiratory changes, and the latter acts on the kidneys by reason of the volatile oil it contains; whisky is uncertain in its effect upon the lungs; while rum, like beer and ale, is a true restorative, as it sustains and increases the vital powers; and he says that the old-fashioned combination of rum and milk is the most powerful restorative with which he is acquainted.

Liebig is of opinion that alcohol is burnt or oxidised in the system, and is therefore a calorific agent; but the researches of Lallamand, Perrin, and Duray, as well as those of Dr. Edward Smith, have demonstrated that a large portion of it passes through the system unchanged, and appears in the breath and perspiration, as well as in the urine. They, therefore, conclude that alcohol is not a food, but is a mere excitor of the nervous centres. On the other hand, Dr. Thudicum in a rather large experiment on the students of his class (33 in number), found that of the 4,000 grammes of alcohol in the 44 bottles of wine which they drank at one sitting, only 10 grammes appeared in the urine; and assuming that about 10 grammes more were exhaled by the breath and skin, he concluded that only 0·5 per cent of the alcohol escaped unchanged. He therefore believes that alcohol is oxidised in the body, and is a true food.

But besides this, the inquiries of Poisseuille have shown that it is a physical as well as a chemical and physiological agent, for it hinders the flow of liquids in narrow tubes, and may act in the same way on the movements of the blood in the capillary vessels. He found, for example, that when the flow of a certain quantity of water through a small tube occupied 575·8 minutes, and of the serum of blood 1048·5 minutes, the flow of the same quantity of Madeira wine under the same circumstances was 1138 minutes, of sparkling Sillery 1463, and of Jamaica rum 1832. Its functions, therefore, are manifestly of a complicated nature; in fact, the whole subject is remarkably obscure, and requires the light of science to illuminate it. As in the case of tea and its allies, ages of empiricism are waiting for a philosophical interpretation.

Lastly, as to the functions of condiments—as peppers, mustard, spices, &c. They are merely stimulants of the digestive organs, promoting the flow of the saliva, the gastric juice, and other intestinal secretions; and increasing the peristaltic movements of the viscera. They thus aid in the processes of digestion; and by giving flavour to the food, they wet the appetite, and so increase the relish for it—indifferent food is thus made palatable, and its digestion accelerated.

And now, in conclusion, we may safely inquire, as a supplementary question to the functions of food, what are the mechanical and thermotic powers, as well as the fattening capabilities of various articles of diet?

Dr. Frankland has made some very careful determinations of the calorific values of different substances used as food; and remembering that every pound of water raised 1° of Fahrenheit represents a mechanical force of 772 lbs. lifted a foot high, it is easy to calculate the working energy of any substance from its thermotic power when burnt in oxygen, or when less perfectly consumed in the animal body. Arranging the results under these two heads, we shall find that the energies of different articles of diet may be expressed as in the following table:—

Actual Energy of Ten Grains of the Material, in its Natural Condition, when completely Burnt in Oxygen, and when Oxidised into Carbonic Acid, Water, and Urea, in the Animal Body.

	Per cent of water in Material.	Lbs. lifted 1 foot high.	
		When burnt in Oxygen.	When Oxidised in the body.
Butter	15	14357	14357
Cheshire cheese..	24	9187	8613
Oatmeal	15	7913	7769
Wheat flour	15	7788	7591
Pea-meal	15	7778	7456
Arrowroot	18	7731	7731
Ground rice	13	7535	7424
Yolk of egg	47	6761	6532
Lump sugar	19	6616	6616
Grape sugar	20	6476	6476
Entire egg	62	4708	4507
Bread crumb	44	4409	4246
Ham	54	3915	3317
Mackerel	71	3537	3187
Lean beef	71	3098	2818
Lean veal	71	2594	2314
Guiness's stout	88	2123	2123
Potatoes	73	2002	1969
Whiting	80	1787	1563
Bass's ale	88	1530	1530
White of egg	86	1325	1138
Milk	87	1306	1241
Carrots..	86	1040	1026
Cabbage	89	858	830

It will be understood, of course, that to obtain these results in the animal body the materials must be completely absorbed, and fully oxidised into carbonic acid, urea, &c.

Estimated in this manner, it may be said that a daily subsistence diet of 2 ozs. of dry nitrogenous food, and 13·2 ozs. of dry carbonaceous, calculated as starch; and a daily working diet of 6 ozs. of dry nitrogenous matter, and 26 ozs. of dry carbonaceous, have the following mechanical energies:—

	Lbs. lifted 1 foot high.	
	When burnt in oxygen.	When oxidised in the body.
Subsistence diet ..	6,319,783	6,307,078
Working diet	13,349,405	13,311,290

But the actual working power of the human body does not approach this. In fact, although a man's daily labour has a very large range, as from 300,000 ft-lbs. when lifting dung into a cart to 1,500,000 ft.-lbs. when pushing or pulling horizontally, yet the average is not above 1,000,000 ft.-lbs., as will be seen from this diagram:—

Kind of labour.	Amount of work in ft.-lbs.	Authority.
Bricklayer's labourer carrying bricks	1,627,200	Mayhew.
Coal whipping..	1,293,600	,,
Ascending Faulhorn	1,074,931	Wislicenus.
,, ,, ...	933,746	Fick.
Treadmill..	1,008,000	Mayhew.
,, ...	861,156	Ed. Smith.
Turning a winch	837,760	Coulomb.
Pedestrians (20 miles a day)	792,000	Haughton.
Paving and pile-driving.. ..	788,480	Coulomb.
Porters carrying loads	732,480	,,
Shot-drill punishment	694,400	Haughton.
Average	967,614	

And even when we add the calculated internal work of a man's body, as the beating of the heart and the movements of respiration, the total of it does not much exceed a million and a half foot-pounds a day:—

	Foot-pounds.
External work or actual labour	967,614
Work of circulation (75 beats a minute)..	497,880
Work of respiration (15 a minute).. ..	98,064
Total ascertainable work per day	1,563,558

It is evident, therefore, that a large portion of our food must escape digestion and absorption; indeed, the thermotic power of the food actually consumed daily, as estimated by the carbonic acid exhaled and the urea secreted, is not more than sufficient to raise the temperature of 10,000 lbs. of water 1° of Fahrenheit. This is equal to a force of 7,720,000 lbs. lifted a foot high; so that the ascertainable work of the food is about one-fifth of its actual energy, the rest of the power being consumed in molecular movements within the animal body. Helmholtz asserts that the external work should be a fifth part of the mechanical force of the digested food; but labour must be well applied to develop this proportion of its energy.

In the steam-engine, according to Sir William Armstrong, only a tenth part of the actual power of the fuel is realised as work. The human machine is therefore more economical of its force than a steam-engine; in fact, it is assumed by Heidenham and others that not less than half of the force applied to the living muscles, as it is developed in their tissue, is utilised. But although the animal machine is so much more economical of force than the steam-engine, yet on account of the costliness of its fuel, &c., it is far more expensive. Taking, for example, a steam-engine of one-horse power (that is, a power of raising 33,000 lbs. a foot high per minute), it will require two horses in reality to do the same work for ten hours a day, or twenty-four men; and the cost would be 10d. for the steam-engine, 8s. 4d. for the two horses, and just £2 sterling for the twenty-four men.

Dr. Frankland has estimated the weight and cost of various articles of food required to be oxidised in the animal body in order to raise 140 lbs. (a rather small man) to the height of 10,000 feet, supposing that only one-fifth of the actual energy of the food is manifested as external work. Here is a part of his table:—

	Ounces required.	Cost.	
Oatmeal	20·5	0	3½
Flour	21·0	0	3¾
Pea-meal	21·4	0	4½
Bread	37·5	0	4¾
Potatoes	81·1	0	5½
Rice	21·5	0	5¾
Beef-fat or dripping	8·9	0	5¾
Cheshire cheese..	18·5	0	11½
Cabbage	192·3	1	0½
Butter..	11·1	1	0¾
Hard-boiled eggs	35·3	1	2½
Lump sugar	24·1	1	3
Milk	128·3	1	3¾
Lean beef	56·5	3	6½
Guiness's stout	6½ bottles.	5	7½
Bass's pale ale	9 do.	7	6

The motive-power of fatty foods is thus shown to be far higher than that of lean meat or farinaceous substances, and this accords with experience, for the labouring classes have long since discovered that fat bacon is a good material for heavy work. Its efficacy may, in great part, depend on the ease and certainty with which it is digested and utilised in the body.

The fattening functions of food are liable to great variation, not merely from the quality of the food itself, but from the peculiarity of the individual consuming it. This is a matter of common observation, and is well known to the breeders of stock. Messrs. Lawes and Gilbert found in their experiments on the feeding of bullocks, sheep, and pigs, that very different quantities of food were required to produce the same increase of weight. Oxen and sheep, for example, feeding on the same diet—viz., oil-cake, hay, and turnips—consume, in one case (that of oxen), 1,109 lbs. of dry substance for every 100 lbs. of increase in the live weight, while in the other the sheep consume only 912 lbs.; and pigs fed on barley-meal will fatten to the same extent on 420 lbs. of the dry material. Pigs, therefore, store up about one-fourth of their food, reckoned in this way; sheep about one-ninth; and oxen only one-eleventh.

The proportions of the several constituents of the food are also very differently used by these animals; for in every 100 parts of the dry food eaten, the several amounts of nitrogenous, carbonaceous, and mineral matters are thus disposed of:—

Constituents of the Dry Food.		Proportions in dry food.	Proportions stored in animal.	Proportions in manure.	Proportions lost in respiration.
Oxen	Nitrogenous	19·66	0·8	29·1	57·3
	Carbonaceous ..	72·86	5·2		
	Mineral	7·48	0·2	7·4	—
		100·00	6·2	36·5	57·3
Sheep	Nitrogenous	19·41	0·8	25·1	60·1
	Carbonaceous.. ..	73·57	7·0		
	Mineral	7·02	0·2	6·8	—
		100·00	8·0	31·9	60·1
Pigs	Nitrogenous	12·38	1·7	14·3	65·7
	Carbonaceous.. ..	85·00	15·7		
	Mineral	2·62	0·2	2·4	—
		100·00	17·6	16·7	65·7

So that the power of appropriation is greatest with pigs and least with oxen; in fact, of every 100 lbs. of the several constituents of the food, the following are the proportions stored up in the three classes of animals:—

	Pigs.	Sheep.	Oxen.
Of 100 Nitrogenous ..	13·5	4·2	4·1
Of 100 Carbonaceous ..	18·5	9·4	7·2
Of 100 Mineral	7·3	3·1	1·9

It will be noticed, too, that the proportions lost in respiration are very different in the three cases; for it is greatest in the pig—amounting to nearly 66 per cent of all the food eaten, and least in the ox, 57·3 per cent. These proportions represent the vital work of the body during the processes of growth and repair.

The time also that is occupied in producing fat and muscular tissue is different with these animals, for the pig increases from 6 to 6·5 per cent of its weight per week; the sheep not more than 1·75 per cent; and the ox only 1 per cent. Some of this difference is doubtless due to the quality of the food made use of, for the pigs were fed on a nutritious and easily digestible diet—oat-meal; while the sheep and oxen made use of food with a large quantity of cellular tissue and woody fibre; and here I may remark that the power of utilising the inferior varieties of food is very different with different classes of animals. Man, as I have already explained, is unable to digest woody fibre, or even the harder kinds of cellulose; it is doubtful, indeed, whether he can digest cellulose at all. The pig, also, has but a limited capacity for this kind of work; whereas oxen and sheep, and the herbivora generally, can eat woody tissues with advantage, and convert them into flesh and fat. In eating meat, therefore, we are utilising the digestive powers of other animals; and are, in fact, employing their stomachs to do for us that which we could not do for ourselves. This, as Mr. Lawes says, is proved, not merely by the testimony of common experience, but also by certain anatomical facts relating to the structure and comparative size of the stomach in different animals. In oxen, for example, the stomach weighs 51 ozs. for every 100 lbs. of live weight; in sheep it weighs 39 ozs.; in pigs 14 ozs.; and in man only 6 ozs. It is manifest, therefore, that the food of man should be more concentrated than that of the lower animal; and that he acts wisely in eating flesh and fat, which are the very essence of food, for he thereby economises labour, and employs the assimilative powers of other creatures to bring the crudest materials into a nutritious and highly digestible form. It is true that man, in common with other animals, is able to convert starch and sugar into fat, and the lower qualities of albumen into flesh, but by so doing he expends force, for in the case of fat he locks up in it twice and a half the potential energy of sugar and starch.

Looking broadly, therefore, at the functions of food, and regarding the animal body as a machine, in which potential energy is rendered active, it would appear that its main duty is to develope force by the oxidation of carbo-hydrogens contained in the blood, and not by the oxidation of tissue. A portion of tissue no doubt decays in the transference of its energies to other forms of action, and requires repair; but the decay is scarcely more rapid at one time than another, and is in no case, when sufficient food is supplied, the cause of mechanical labour. "In man," says Dr. Frankland, "the chief materials for muscular power are non-nitrogenous; but nitrogenous matter can also be employed for the same purpose, and hence the greatly increased evolution of nitrogen under the influence of a flesh diet, even with no increase of muscular exertion. The non-nitrogenous matters, also, which find their way into the blood, yield up all their potential energy as actual energy; whereas the nitrogenous in leaving the body as urea carry with them a portion (at least one-seventh) of their potential energy unexpended. The transference of potential energy into muscular power is necessarily accompanied by the production of heat within the body, even when the muscular power is exerted externally. This is, doubtless, the chief, and probably the only source of animal heat."

(To be continued.)

FOREIGN SCIENCE.

PARIS, OCT. 21, 1868.

Employment of Vegetable Tar in Dyeing.—New Process for Generating Chlorine.—A Thallium Detonating Mixture.—Manufacture of Permanganate of Potash.—Pulverised Coke in Piles of great Resistance. ACADEMY OF SCIENCES.—Menaphthylamine.—Caproic and Caprylic Fermentation of Ethylic Alcohol.—Formation of Caproic Alcohol in the Caproic Fermentation of Common Alcohol.

M. LEFORT has published a note on the employment of vegetable tar in dyeing. In the year 1851, M. Pettenkoffer observed that wood vinegar exposed to the action of ammonia and of perchloride of iron, became coloured a deep violet. M. Pauli, his assistant, endeavoured to isolate the substance which caused this reaction, and obtained, by treating the acetic acid from wood with sulphuric ether, an acid crystallising in fine needles, very soluble in water, alcohol, and ether, presenting the characters of pyrogallic acid; subsequent examination, however, proved this body to be pyrocatechuic acid. The circumstances under which oxyphenic acid is produced, and the very deep colouration acquired by tar water upon the addition of a salt of sesquioxide of iron, led M. Lefort to think that vegetable tar might be useful in dyeing textile matters. Experiments in this direction have left no doubt as to its applicability. According to analyses made, vegetable tar contains on an average about 1 per per cent of oxyphenic acid, and as this acid is very soluble in water, the more concentrated the solution, the more coloured the dye bath. Upon the addition of perchloride of iron, the tar water is immediately coloured a dirty green, which is changed to a violet tint by the addition of potash or ammonia; but, with or without the addition of alkali, the oxyphenate of iron formed under these circumstances fixes itself upon animal and vegetable fibres, to which it communicates an ash-grey colour of great solidity. To dye textile matters with oxyphenate of iron, the following is the method of operating:—The fibres are steeped in a solution of perchloride of iron for several hours, and, when sufficiently drained, transferred to a vessel of filtered tar water, containing one of vegetable tar to ten of water, heated to 60° or 80°. After several hours' maceration, they are withdrawn, washed with water, and afterwards with soap to remove the aromatic and resinous principles. Soap does not act upon the colouring principle which is fixed upon the fibres, and the resulting impression presents all the solidity common to pigments having iron for the basis.

A Belgian chemist has devised a new process for generating chlorine. He first forms trisulphate of sesquioxide of iron, by the direct combination of this oxide with sulphuric acid, and then mixes the trisulphate obtained with 3 equivalents of chloride of sodium or other convenient chloride. Upon heating the mixture in dry air, the chloride of sodium yields all its chlorine.

M. Bœttger has formed a mixture which inflames by friction, of 8 parts of teroxide of thallium and 1 part of protosulphide of antimony.

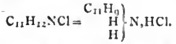
Some facts worthy of attention, concerning the manufacture of permanganate of potash, have been pointed out by M. Staedeler. In the preparation of this salt by heating a dilute solution of the manganate, a third of the manganic acid is reduced to the state of peroxide without taking part in the reaction; the case is the same when hydrochloric acid is used to effect the transformation, notwithstanding that this process permits of the use of concentrated solutions. Things happen differently when chlorine is employed. The following is a convenient method of operating:—The crude pulverised manganate is abandoned in its own weight of water for several days, then a similar quantity of water is added, and a current of chlorine transmitted until the liquid becomes red; the solution is frequently agitated, diluted with four times its volume of water, filtered through coarsely powdered glass, and reduced to one-fifth of its original volume. At this point the permanganate crystallises; it can be obtained in a state of purity by recrystallisations. The yield is 90 per cent of the weight of peroxide of manganese employed.

A note entitled "On the Part Played by Pulverised Coke in Piles of Great Interior Resistance," by M. Gaiffe, was communicated at a recent meeting of the Academy. In examining the action of the pounded coke which is placed round the carbon in the piles of M. Leclanché, M. Gaiffe has been led to conclude that this addition considerably augments the surface of the carbon element, and extends this surface to within a very minute distance of the porous vessel; it is probable that the employment of coke powder would give good results in all piles of great interior resistance. The experiment was made with two batteries, the one sulphate of lead, the other sulphate of protoxide of mercury. Their interior resistance was much diminished, and their constancy became nearly perfect. The deviation of a galvanometer with thick wire and not very sensitive, in permanent communication with the mercury battery, only varied one degree in four and twenty hours; it was 28° at the moment of closing the circuit, it was still 27° twenty-four hours later.

Among the memoirs presented to the Academy on August 31st, were the following:—"On the Induction Spark," by M. Seguin; "Protoxide of Nitrogen as an Anæsthetic Agent," by M. Evan; "Density of Uranium," by M. Peligot; "New Exciting Liquid for Bunsen's Battery," by M. Delaurier; "On the Spontaneous Alcoholic and Acetic Fermentation of Eggs," by M. Béchamp. We may possibly return to one or two of these papers.

At the meeting on September 7th, M. Hofmann contributed a note on menaphthylamine, M. Delaurier addressed a further note relative to a new modification of Daniell's battery, and from M. Béchamp there were two memoirs "On the Caproic and Caprylic Fermentation of Ethylic Alcohol" and "On the Formation of Caproic Alcohol in the Caproic Fermentation of Common Alcohol.

M. Hofmann was led from the preparation of menaphthylamine oxalic acid, by means of cyanide of napthyl, to study the behaviour of this latter body under the influence of nascent hydrogen, with a view to the formation of the primary menaphthylic monamine. Hydrogen only combines with cyanide of naphthyl with extreme slowness. After a week's treatment with zinc and hydrochloric acid, the cyanide only furnished a little menaphthylamine, while there remained with the unaltered cyanide menaphthoxylamide and likewise menaphthoxylic acid. In the presence of this difficulty, the idea suggested itself of reducing the sulphuretted amide, which is easily prepared with the aid of nitrile. The experiment completely succeeded. Upon treating an alcoholic solution of menaphthothiamide with hydrochloric acid and zinc, torrents of sulphuretted hydrogen were developed. By continuing this treatment until sulphuretted hydrogen is no longer given off, which requires two or three days, a solution is obtained from which scarcely anything is precipitated by water. Then concentrated solution of soda is added until the oxide of zinc precipitated is dissolved; an oily layer, still containing much alcohol and soda, soon rises to the surface. The oily layer is removed by a pipette, and heated upon the water-bath to free it from alcohol. There remains an aqueous solution of soda, on which floats a yellowish oil; this oil is menaphthylamine, only containing a small quantity of cyanide of naphthyl regenerated from the thiamide. By treatment with hydrochloric acid the nitrile is left insoluble; the addition of soda causes the separation of the base in a state of purity. Menaphthylamine is an extremely caustic liquid, having a point of ebullition between 290° and 293°. Recently distilled, it is colourless; but it soon acquires a yellow tint. Carbonic acid is absorbed by it with such avidity that a pellicle of carbonate is formed in merely transferring the liquid from one vessel to another. The composition of this base was given by theory, but it has nevertheless been established by the analysis of the chloride and of the platinic salt. The chloride crystallises easily in long needles, difficultly soluble in water, having the composition—



$$C_{11}H_{12}NCl = \left.\begin{array}{r} C_{11}H_9 \\ H \\ H \end{array}\right\} N,HCl.$$

The yellow crystalline precipitate which is formed upon adding chloride of platinum to the chloride, contains—

$$C_{22}H_{24}N_2PtCl_6.$$

Thus the formation of menaphthylamine by means of its thiamide is seen to be simply the replacement of two atoms of sulphur by hydrogen—

$$C_{11}H_9NS + 2HH = C_{11}H_{11}N + H_2S.$$

The salts of menaphthylamine are easily crystallised. The sulphate and nitrate are difficultly soluble; the crystals of the latter resemble saltpetre. In contact with sulphide of carbon, menaphthylamine becomes a crystalline mass; in contact with alcoholic soda and chloroform, formo-menaphthylnitrile is produced. M. Hofmann has likewise prepared benzylamine by means of thio-benzamide.

M. Béchamp remarks that ordinary alcohol can ferment. For this, it suffices to dilute the alcohol, introduce chalk containing microzymas, and a little syntonine or washed meat. The chief products of the reaction are caproic acid and hydride of methyl; at the same time hydrogen and carbonic acid are evolved, but this latter gas occurs exclusively from the carbonate of lime of the chalk. The caproic acid is accompanied by other acids, some more and others less volatile. Acetic, valeric, caproic, and caprylic acids have been isolated.

The crude product of the caproic fermentation of alcohol possesses an aromatic odour, resembling that of fusel oil. The untransformed alcohol separated has the same odour. This alcohol being rectified, there passes at the end a liquid which renders water milky. It is in these last portions that the caproic alcohol is found; resort was had to fractional distillation to place this in evidence. The alcoholic mixture was rectified a great number of times upon caustic potash, a part of the ultimate products being taken each time from the point when they commenced to render water milky. A final rectification on fresh caustic potash precluded the presence of ethers of fatty acids. The products thus obtained were oxidised by the "classical mixture" of bichromate of potash and sulphuric acid, the acid liquid distilled being separated, by a rectification on carbonate of soda, from the aldehyds and ethers formed; these, oxidised in their turn, furnished a fresh quantity of acid, and so on. At a certain moment the oxidised product had the odour of valeric aldehyd. The salts of soda obtained were separated from the acetate by crystallisation; decomposed finally by sulphuric acid, they furnished a layer of oily acids, the caproic and valeric odour of which left no doubt as to their nature. These acids transformed into baryta salts, were separated according to the process formerly employed by M. Chevreul. M. Béchamp obtained a notable quantity of caproate of baryta, which he analysed; but caproic acid does not alone exist in the mixture, for amongst the baryta salts obtained there are some more and others less soluble than the caproate. The two memoirs by M. Béchamp refer to the same subject; each has contributed a part to your correspondent's account of these interesting experiments.

CORRESPONDENCE.

OZONE.

To the Editor of the Chemical News.

Sir,—It may, perhaps, prove interesting to some of your readers if I point out three sources of error to which many of the discrepancies in the registration of ozone may be due.

1st. The test-papers employed are not of *uniform* quality—some are more sensitive than others.

2nd. There does not appear to be any *uniform* method adopted of exposing the test papers to the influence of the atmosphere.

The amount of ozone present, as indicated by test-papers exposed in various ways (as, for instance, in Moffat's ozonometer box, Sir James Clarke's ozone cage, or from the roof of a thermometer-stand), will vary most considerably, and be a source of the greatest confusion. To give an example:—From July 30th to September 24th, 1262, Mr. Atkinson simultaneously exposed two sets of similar test-papers—one set in a perforated box, the other in his thermometer-stand. The result of his experiment was that the amount of ozone indicated by the papers placed in the thermometer-stand was *more than double* of that indicated by the papers in the perforated box (*Proc. Met. Soc.*, vol. i., p. 307).

3rd. There appears to be no *uniform* time during which the papers are exposed. One observer changes his papers every twelve hours; another, every twenty-four hours. Now the amount of ozone found by the one observer will differ very considerably from that found by the other. Here, then, is another fertile source of error.

I believe that if observers would all employ test-papers of a *uniform* quality, expose them in the *same* way, and for the *same* time, many of the discrepancies at present so apparent in the registration of ozone would be found to disappear.

At any rate, the experiment is worth trying, and if ten or twelve observers, in different parts of England, would kindly forward me the result of their observations, conducted on the following plan, for, say a period of three months, I should be much obliged:—

Let the test-papers used be Schönbein's, as sold by Casella; let them be exposed in Sir James Clarke's ozone cage, and let them be changed every twelve hours, at say 9 a.m. and 9 p.m.—I am, &c.,

R. C. C. Lippincott, F.M.S.

Over Court, near Bristol,
Oct. 19, 1868.

MISCELLANEOUS.

Science Teaching in Southampton.—On Thursday afternoon a very interesting experiment was commenced at the Hartley Institution, which may have results of a rather important character in Southampton. The experiment itself was simply the delivery by Dr. Bond, the principal of the institution, of the first lecture of a course on "Experimental Physics," adapted for young persons; but what renders it especially interesting is the fact that the greater part of the audience on the occasion consisted of about 200 boys, who had been selected from the national and other similar schools of the neighbourhood, and who, with their teachers, will be admitted gratuitously to the course. The object which Dr. Bond has in view in making this experiment, which has grown out of a conference with the teachers held a short time ago in the institution, is two-fold—firstly, to prepare a certain number of the boys for the examinations of the Department of Science and Art, and for competition for the Local Science Exhibition, which has lately been founded by the council of the institution, in conjunction with the Lords of the Privy Council, for artisans in Southampton; and secondly, to lay the foundation of a regular system of science teaching in the national schools of this neighbourhood. It is hoped that this will be effected by the opportunity which the masters will have of qualifying themselves by attending the course for obtaining the science certificates of the Department of Science and Art, and thus earning payment for themselves on results. They will also be the better enabled, by having themselves heard the lecture, to prepare the boys in the subjects of each, to facilitate which, at the close of each lecture, a printed syllabus of the ensuing one is distributed at the door. We believe that this is the first occasion on which such an experiment as this has been made, here or elsewhere, and we cannot but think that if it were followed generally in our larger towns the problem of how to introduce science into our artisan schools, in the absence of trained teachers, which now prevails, would be simply and rapidly solved. We may also add that in making the proposal to the teachers to establish this class, Dr. Bond offered to hand over to them all payments which might be made to him by the Department of Science and Art on account of the boys attending the class who might take certificates at the examinations of the Department, on condition that the teachers would undertake to supplement the work of the lecturer by preparing the boys in school for the examination, thus giving the teachers a direct personal interest in the work of the class.

The Water Supply of Towns.—Newspaper readers cannot have failed to notice the monthly returns in which the Registrar-General superadds to the tables of death and disease some irrelevant returns of the analysis of water. Only a few leisurely and sceptical students take the trouble to ascertain that the connection between mortality and apparent impurity of water is entirely hypothetical. The Registrar or his subordinates understand the law of mental association, if not the physical properties of water, and as the discussion at Birmingham proved, they have, like their favourite element, by constant dropping, worn into the popular mind the belief that impure water is the origin of all diseases. If it were possible to publish statistical tables of food, of cookery, of air, of exercise, of overwork, of anxiety, and of all other conditions of health and disease, it would be proper to include in the list the analysis of water. The juxtaposition of one among many causes with a complex effect can only suggest a fallacious result, yet the error or superstition is almost innocuous because it tends in a safe direction.—*Saturday Review.*

NOTES AND QUERIES.

Drying Oils.—I want to render unboiled linseed oil a quickly drying oil. I have tried Liebig's plumbic oxide and acetate process, but do not find it do well. Ure's "Dictionary" directs 1,000 of manganic borate to be added, but this does not do with me. I want to do away with the boiling or heating of the oil, and if any of your contributors will kindly give any information I will feel greatly favoured.—Waterproof.

TO CORRESPONDENTS.

X. Y. Z.—The process is not practically applied. It succeeds very well in the laboratory; but carried out on the large scale it is a failure.

W. W. W.—Our publisher will forward the Cehmical News if you will send a proper address.

J. Horsley.—Our correspondent's letter was received; but as it related almost entirely to controversial matters respecting priority of an invention, we considered it was not adapted to our pages.

J. H. W.—Much of the misunderstanding which exists at present amongst theoretical chemists arises from the confusion of terms. You will do more good to the cause you wish to advocate by refraining from making public your views on atomicity. This term is generally used in quite another sense from the one in which you apply it.

Chemicus.—An aqueous solution of platino-chloride of potassium constitutes a very good reagent for thallium in dilute solutions. Collect the precipitate and test it in the spectroscope. Rubidium and cæsium will be precipitated at the same time if present.

Communications have been received from H. W. Wilson; J. Spicer (with enclosure); The Secretary of the Rivers' Commission; D. Forbes, F.R.S.; E. J. Gilpin; Dr. S. Muspratt; J. Horsley; Dr. Röhrig; Messrs. Brooke, Simpson, and Spiller; Gossage and Sons; J. How; Maclachlan and Stewart; J. Woodcock; and F. Herapath.

THE CHEMICAL NEWS.

Vol. XVIII. No. 464.

ON SOME BORACIC ACID MINERALS OF PERU.

By J. WALKER, Pisagua, Peru.

Under the names of tinkalzite, boracite, boronatro-calcite, borate of lime, and tiza, you have at various times published contributions describing the Peruvian mineral known in commerce as borate of lime. Some of your contributors hold opinions at variance as to the chemical constitution of this mineral, and seem to delight in racking their brains to construct a formula that will agree with their particular analysis.

For example Dr. T. L. Phipson, in No. 96 of the Chemical News, gives us the formula—

$$(NaO,2BO_3 + 10HO) + (2CaO,BO_3 + 2HO) + 2HO;$$

G. Lunge, in No. 377, gives—

$$2(NaO,2BO_3) + 5(CaO,2BO_3) + 42HO,$$

and in the same paper he informs us that Dr. Krant's formula is—

$$NaO,2BO_3 + 2CaO,3BO_3 + 15HO;$$

and that of Rammelsberg—

$$NaO,2CaO,6BO_3 + 18HO.$$

In No. 385 Professor How supports the formula of Dr. Krant.

Being on the spot where this so-called borate of lime is collected, I took the opportunity of selecting seven distinct specimens, and subjected them to analysis with the following results:—

	1	2	3	4	5	6	7
Boracic Acid	41·30	41·50	31·42	24·93	39·25	8·42	30·87
Silicic Acid..	—	—	—	2·40	—	—	—
Lime	7·40	12·90	11·33	12·72	13·76	2·46	9·90
Soda	11·90	4·50	4·90	—	2·64	1·20	5·18
Chloride of Sodium ..	0·70	0·70	1·40	0·95	3·15	37·10	0·45
Sulphate of Soda ..	0·50	4·10	2·15	11·13	7·30	26·12	0·60
Sulphate of Lime ..	—	—	—	14·57	—	—	—
Sand and Insoluble ..	0·60	1·50	19·70	3·80	3·70	16·90	26·80
Water	37·60	34·80	29·10	29·50	30·20	7·80	26·20
	100·00	100·00	100·00	100·00	100·00	100·00	100·00

I will not attempt to construct a formula from any of those analyses, but will simply suggest a possible explanation of the differences in composition. Spread over the same pampa where the borate occurs are numerous deposits of chloride of calcium and sulphate of lime. Even under a tropical sun where it never rains, those deposits retain sufficient moisture to keep them quite soft like half-dried mud. In passing over such interesting ground, which extends in some places for miles, the mule on which I rode sank often up to the knees in this well-known deliquescent salt. Now suppose a mixture of solutions of chloride of calcium with biborate of soda, or other compound of boracic acid and soda, to take place, the composition of the resulting deposit would of course depend upon the proportions in which such solutions were mixed.

The seven specimens which I have collected and examined represent so many distinct deposits occuring in different basins. There is every probability that the formation of the mineral is due to precipitation, the after shrinking of such a gelatinous precipitate accounting for the nodular form in which it is found. It would be very easy to select specimens with composition varying from almost pure biborate of soda to that having none of this substance at all, such as is shown in analysis No. 4, which has evidently been formed from sulphate of lime and an indefinite compound of soda with boracic acid, only a small part of the resulting sulphate of soda having drained off. The richest specimens are probably formed from chloride of calcium and a sodio-boracic salt, the resulting chloride of sodium, owing to its solubility at ordinary temperatures, draining off more readily than sulphate of soda under the same circumstances.

I am induced to send you these analyses and remarks in the hope that they may be interesting, not only to your formula-constructing friends, but to your readers in general.

To chemical manufacturers in England, who use this substance for the manufacture of borax by boiling in a solution of carbonate of soda, it would be very important for them to avoid such descriptions as is represented by analysis No. 4, the large proportion of sulphate of lime not only rendering an equivalent proportion of carbonate of soda now effectual, but introducing so much sulphate of soda in solution with borax as to cause more manipulation with the production of an inferior article.

Pisagua, Peru, August, 31, 1868.

FLUX FOR BLOWPIPE ANALYSIS.

Mr. Stephen D. Poole has communicated the following note to the *Scientific American*:—Among the various methods of testing the presence of substances in chemical examinations, that by means of coloured flames seems to be of growing importance, not alone with reference to the application of the spectroscope, but in the ordinary use of the blowpipe or gas flame. For unmasking lithia, &c., the books prescribe a mixture of bi-sulphate of potash and fluor spar; but this flux is objectionable, on account of the intense violet tint (potash) which may disguise the reaction due to the presence of small quantities of other substances. Fresenius directs that silicates be mixed with sulphate of lime; but this salt is, by itself, infusible, and its power of decomposing the natural silicates small. On the other hand, a mixture of sulphate of lime and fluor spar, in equivalent proportions (say about two parts of crystallised selenite to one of fluor spar finely mixed), forms an easily fusible bead, which by itself gives only a very faint dull red tint (lime) to the flame, but which renders the presence of such elements as give colour most beautifully evident and characteristic.

Thus, small portions of lepidolite, petalite, &c., mixed with this flux, impart the fine carmine tint; copper, strontium, their well known colours, especially after continued blowing. Potash and soda minerals (felspar and albite) are at once distinguished.

Presuming that many of your readers are interested in Determinative Mineralogy, I invite them to make use of the above-named reagent, and if possible extend its utility.

ON SPECIFIC GRAVITY OF TINCTURES.*

By W. LAIRD, Ph.C.

In the P. B., in common with other pharmacopœias, after the formula for the preparation of a good many of the acids, liquors, and solutions, we have a note of the "characters and tests" of the various products. On looking over the P. B. it occurred to me that it was a pity that the compilers had not carried out the same rule in the section for tinctures. In two cases only is there any mention made of the characters the product is expected to possess,—Tinct. Opii and Tinct. Ferri Perchloridi. It is surely of as much importance for us to know the sp. gr. of any of the other tinctures as of Tinct. Ferri. Why tell us that sp. gr. of Syrupus is 1·330 and say nothing of that of Tinct. Opii; or why tell us that Syr. Rhamni is 1·32 and say nothing of Syr. Rhei, Scillæ, or Zingib? If useful in the one case it would be in the other. Being strongly impressed with this idea, I would suggest that the members of this Conference might aid in completing this portion of the P. B. by recording the sp. gr., and also any peculiarity of tinctures as prepared by them, and forwarding their notes to the meeting. Some may be inclined to think this useless trouble, but I have a case in point, showing a knowledge of the sp. gr. of a tincture to have been useful in at least one instance in the detection of unfair trading.

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* Read at the Norwich Meeting of the British Pharmaceutical Conference.

Some time ago I was told of a person who was selling tincture of ginger for 2s. per 16 fluid ounces. I at once said it could not be good, but was assured that it was so. I procured some of the tincture in question, and found its sp. gr. to be ·898 instead of ·840 as I had previously found it to be when made according to the P. B. On separating the spirit I found it to be ·895, or 26 per cent instead of 50, showing that this tincture was made with a spirit 16 overproof instead of that required by the P. B. The money value of the spirit would be about 15s. 7d. instead of 22s.

The present duty on 60 per cent is 16s. 0d.
" " 16 " 11s. 7¼d.

Loss to Revenue .. .. 4s. 4¾d. on every gallon of this tincture sold. This portion of the question we may, I presume, leave to the excise; and we will rest content if our bringing this under notice result in ultimately establishing an approximate standard of sp. gr. for all tinctures. I subjoin that of those I have myself kept note of:—

Tinct. Benzoin Co.	·898
" Camph. Co.	·927
" Cardam. Co.	·955
" Catechu	·960
" Lupuli	·930
" Myrrhæ	·845
" Opii	·940 } average of three makings.
" Zingiber	·840

While on this subject, may I be allowed to ask what should be the sp. gr. of Decoct. Sarsæ Co.—1 to 7? I have two samples purporting to be of same strength; one is 1·105, while the other is only 1·04!

OBSERVATIONS ON EXTRACTUM CARNIS (LIEBIG).*

By THOS. T. P. BRUCE WARREN.

If an aqueous solution of extractum carnis be digested with a large quantity of rectified ether, there is found on the surface of the solution, after a short time, a substance which does not dissolve in the supernatant ether, and if mixed mechanically, by agitation, with the solution, again separates, occupying the same position as before.

I was led to this observation on examining extractum carnis for fatty and gelatinous matters about four years ago, during which time the contents of the bottle have remained undisturbed. I convinced myself at the time of its not being either of a gelatinous or fatty character; and not being at the time acquainted with a substance of such an apparently intermediate relation, I thought it would be interesting to determine at a future time the properties which this substance possesses as compared with the already examined principles existing in extractum carnis, and to compare it with the proximate principles existing in animal tissues, and which are possible to exist in extractum carnis.

The ether was first carefully decanted, and the solution separated by filtration, the substance remaining on the filter was thoroughly washed with boiling water.

On the surface of the solution it appeared as a jelly-like stratum, with a large quantity of air bubbles invariably adhering to it, and which were removed only by drying.

It possesses in an eminent degree the smell peculiar to the extract, and is decomposed by heat without melting. It is not dissolved by boiling water.

In dilute acetic acid, the caustic alkalies, and alcohol it is partially soluble. Its alkaline combinations yielded no crystals.

These results, and notably that of its swelling in water without dissolving, and its insolubility in ether, show that it consists principally of cerebric acid, derived probably from the nerves which ramify the parts from which the extract is made.

A suggestion arises, that cerebric acid, as transpersed through the nerves of the muscles, may have a distinct modification to that found in the brain, for its insolubility in water should prevent its appearing in the extract even in the smallest quantity.

PURIFICATION OF TIN ORES FROM WOLFRAM.

Owing to its great specific gravity, and its undecomposability, wolfram cannot be separated from tin ore by mechanical dressing, by roasting, or by treatment with acids. If present in larger quantity it alloys the tin and renders it difficult to fuse. In Cornwall, wolfram is separated by Oxland's smelting method, which may be carried out with two modifications; namely, by employing carbonate of soda, or sulphate of soda, both for the purpose of forming soluble tungstate of soda.

At East Pool mine this process is carried on in reverberatory furnaces, furnished with an iron pan instead of a hearth, and so constructed that the flame from the grate passes first over the fire-bridge along the surface of the pan, then across a bridge, which lies opposite the fire-bridge, and through flues under the bottom of the pan, into a channel leading into a chimney.

The use of the cast-iron bed effects considerable economy of fuel, and it is admirably adapted for the calcination of raw ores, and the evolution of sulphur and arsenic contained in them, but it is especially useful instead of fire-bricks or tile, by preventing the loss which would result from the reaction of the soda ash on the silica of the brick, giving rise to the formation of double silicate of soda and tin.

According to the fineness of the schlich, charges of from 6 to 9 cwts. of ore are made (the finer the ore the lighter the charges), and from 9 to 12 lbs. of carbonate of soda (containing 48 per cent of alkali) per cwt. of ore, are spread over the heated ore; one or two shovel-fuls of coal are thrown upon that part of the hearth opposite the fire-bridge, in order to obtain a temperature as uniform as possible. The mass is kept at a white heat for about six hours; it is stirred every quarter of an hour, and every half hour some coal is thrown upon the back of the hearth. Half the charge is now removed from the furnace, then, after one more stirring, the other half. About 1½ tons of ore, with 330 lbs. of carbonate of soda, are treated in four charges, yielding in 24 hours about 10 cwts. of pure tin ore. The mass when heated in a pasty state, and after cooling being frothy, is broken in pieces the size of an egg, mixed with 25 per cent of quartz, and pounded under a stamping mill, the quartz serving to separate the hard alkali crust from the tin ore. The pounded mass is repeatedly washed, the coarser part pounded two or three times with quartz, and sometimes again treated with soda in the reverberatory furnace. This preparation is comparatively expensive, and it causes a considerable loss of tin ore both mechanically and chemically; the chemical loss arises from the formation of soluble stannate of soda.

When sulphate of soda is used instead of carbonate of soda, the loss of tin is lessened and the process cheapened, but it is rendered more difficult as the reaction must be alternately oxidating and reducing. The dressed ore is mixed with sulphate of soda, according to the amount of tungsten in it, so that approximately tungstate of soda may be formed; some pulverised coal is added, and the mixture heated in a reverberatory furnace by a smoky reducing flame, whilst the mass is continually raked; the sulphuric acid of the sulphate of soda decomposes, and the liberated soda combines with tungstic acid when treated by an oxidating flame. The red-hot mass is removed from the furnace and thrown into a cistern full of water, after about six hours, and when the colour and other qualities of the roasting mass indicate its decomposition. After 24 hours the solution of the tungstate is caused to run off through a sieve attached to one of the sides of the cistern; the remaining tin stone is then washed again to remove the peroxide of iron mixed with it, which originated from the tungsten. Four charges, equal to 36 cwts., of schlich are treated in 24 hours, consuming 4 or 5 tons of coal.

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* Read at the Norwich Meeting of the British Pharmaceutical Conference.

The whole of the solution of tungstate of soda is sometimes boiled down, and the crystallised salt used for dyeing purposes, for rendering fabrics non-inflammable, also for bleaching linen, for the production of bronze colours, &c.

At Zinnwald, in Bohemia, wolfram is separated mechanically, and sold at about 10s. 6d. per cwt. In 1859, 25¾ tons were produced; in 1860, only 5 tons.

At Schlaggenwald (Preuss. Zeitschr., 1862, Bd. x., Leif. 3, p. 165), 4 or 5 cwts. of ore, with an admixture of common salt, are roasted in a reverberatory furnace for eight hours, at a consumption of 25 cubic feet of coal. The chloride of copper, and tungstate of soda thus formed are lixiviated with water, and the copper in the lixivium is precipitated by iron, and tungstate of lime by means of chloride of calcium; the lixiviated ore is washed again.

ON THE BALLAGAN SERIES OF ROCKS.*

By J. WALLACE YOUNG.

In a former paper read before the Society,† I pointed out the general composition of some rocks known as the "Ballagan Limestones;" since then, however, I have made a more minute investigation of the rocks of the series, more particularly as they are developed in Ballagan Glen.

In the fine section there exposed, there are, I understand, upwards of 230 alternating beds of dolomitic limestones, sandstones, and shales. The limestones vary in thickness from 1½ inches to about 1 foot. They partake somewhat of a nodular character, and are quite amorphous in structure; the colour is usually grey, but some layers have a more or less red tinge. Some of these are very hard, others again break easily into splintery fragments.

The shale beds parting the limestones are sometimes not over 1½ inches thick, but more frequently from 1 to 2 feet; they vary from a sandy shale to a fine clay shale, and all more or less effervesce with hydrochloric acid. The following analysis may serve to give some idea of their composition:—

Dried at 100° C.

Sand and Clay	77·61	per cent.
Soluble Silicic Acid ..	2·73	,,
Lime	2·15	,,
Magnesia	1·59	,,
Oxide of Iron and Alumina	8·37	,,
Carbonic Acid	1·64	,,
Water and Loss	5·91	,,
	100·00	,,

The sandstones are impure, consisting of quartz grains cemented with felspathic matter; treated with hydrochloric acid, a mere trace of carbonic acid was given off. The sandstones and sandy shales contain abundance of small fragments of mica.

Horizontal layers of white fibrous gypsum are common, and a red granular variety is found generally at right angles to the other; this last being of more recent date than the white, which from its position must have been formed at, or shortly after, the deposition of the shale beds.

Eight specimens of the limestone were taken from different beds, proceeding from the lowest to the very highest of the series, in order to determine the relative quantities of lime and magnesia. The following table gives the result of the analysis:—

Dried at 100° C.

	1	2	3	4	5	6	7	8
Insoluble	18·12	22·40	18·40	21·60	13·59	20·50	20·55	23·25
Lime ..	24·16	23·35	23·80	23·50	26·99	24·25	24·10	23·00
Magnesia	16·35	14·15	17·20	14·25	17·21	15·00	15·15	15·10

No. 1 was from the lowest exposed bed; colour, reddish. Nos. 2, 3, 4, 5, 6, 7, and 8, beds in ascending order; colour, grey. It must be understood that these specimens were taken from every eighth or tenth alternate layer of limestone, and represent the whole vertical height of the exposed strata. A full analysis was made of the specimen marked No. 5, in order to give some idea of the general proportion of the other ingredients.

No. 5.—Dried at 100° C.

Clay and Sand	Insoluble matter	11·92	per cent.
Silicic Acid		1·67	,,
Lime		26·99	,,
Magnesia		17·21	,,
Protoxide of Iron		0·64	,,
Oxides of Iron and Alumina		2·67	,,
Carbonic Acid		38·00	,,
Loss, &c.		0·90	,,
		100·00	,,

In this analysis it will be observed that the carbonic acid is less than is required for the formation of the normal carbonates of lime and magnesia; some part of either, or both, must therefore have been combined with the silicic acid. The insoluble matter when fused with alkaline carbonate, and tested in the usual manner, was found to consist of silicic acid and alumina (or clay), and only very small quantities of lime and magnesia. Notwithstanding the presence of so much gypsum in the series, I could not detect anything but the merest traces of sulphuric acid in any of the specimens examined. However, in Auchenreoch Glen, near Dumbarton, where this same formation occurs, the limestones were found to contain no inconsiderable quantity of sulphuric acid, and fissures are often found filled with radiating crystals of gypsum.

I had intended examining in a similar manner some of the dolomitic limestones from the other localities where this formation is exposed, but I have been only able as yet partially to examine two varieties from the beds situated in the hills above Greenock. The strata are there inclined at a pretty high angle, but have a similar appearance to those in Ballagan Glen. I could not find here any gypsum, but there are abundant layers of white fibrous carbonate of lime, and which presents the same aspect, and occupies a similar position to the gypsum in Ballagan Glen.

The following table exhibits the proportions of insoluble, lime, and magnesia, in the two beds:—

	I.	II.
Insoluble ..	8·35	5·7
Lime	28.65	29·55
Magnesia ..	18·25	19·25

These specimens are much purer than the others, and it would be interesting to find out what relative position they occupy, with regard to the strata in Ballagan Glen, seeing they are so far apart.

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* Transactions of the Geological Society of Glasgow.

† Vol. xxxiv., p. 64, "On the presence of Magnesia in Rocks."

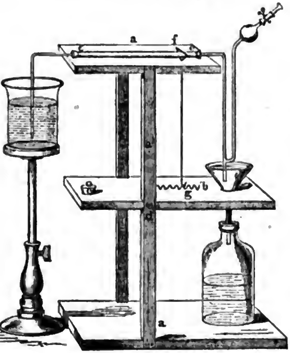
I do not think that we can explain the formation of these beds upon the supposition that they were originally limestone, and subsequently converted into dolomite. From their somewhat nodular structure, and impure character, it appears as if they had rather proceeded from the segregation of a dolomitic mud, so to speak. At all events it is quite evident that the conversion—if such was required—must have taken place at, and not subsequent to, their deposition. The presence of gypsum in the series does not support the idea that the magnesia may have originally existed as sulphate, the relative amount being so small.

DESCRIPTION OF AN
AUTOMATIC ARRANGEMENT FOR CONTINUOUS FILTRATION AND WASHING PRECIPITATES.

By HENRY B. BRADY.

[A working model of the apparatus was exhibited at the Norwich meeting of the British Pharmaceutical Conference, and an extempore description was given, of which the following is a summary. As the arrangement requires modification for the two distinct operations for which it is designed, it will be necessary to give a separate description of the two forms. Woodcuts 1 and 2 illustrate the subject.]

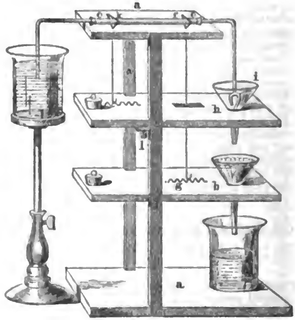
Continuous Filtration (Fig. 1).



The arrangement for continuous filtration is exceedingly simple. The object is to keep a filter constantly filled up to a certain height. The rigid stand, *a a a a*, consisting of two horizontal boards connected by two uprights, may be replaced by any convenient laboratory fittings, its object being to carry a funnel-holder, *b*, which swings freely on a pivot, *d*, One arm holds the funnel, the other is balanced by a suitable weight, *c*. A vulcanised india-rubber tube, *e e*, and a wire stirrup, *f*, are the only other essential portions of the arrangement. The stirrup encircles the flexible pipe, and, passing through the upper board, is connected with the arm which holds the funnel. A wire rack, *g*, is added as a convenient means of regulating the pressure of the stirrup.

It is obvious that if the counterpoise on the centre board is adjusted so that the weight of the filter when filled to the height desired will turn the scale, the pressure of the stirrup on the india-rubber tube will immediately cut off the supply. In practice it is found that the supply very soon adjusts itself exactly to the rate of filtration, and then the funnel remains stationary. The fluid may be supplied in many ways; a common washing-bottle answers very well, or a tap-jar may be employed, or any other similarly convenient appliance. The drawing shows a somewhat more complicated arrangement, in which the supply is brought from an open beaker by means of a syphon, in which case the suction-pipe must be kept closed by a pinch-cock.

Washing Precipitates (Fig. 2).



Object, to provide an intermittent supply of fluid in such a way that the filter shall empty itself completely before it is filled again. The same rigid stand, and the same oscillating funnel-board are used, but there is superadded another board like *b*, suspended in the same manner a little above it, as seen at *h*. This intermediate member holds a funnel, *i*, fitted with a Tantalus syphon, immediately above the funnel used for filtering, and has a wire and stirrup, *k*, working from the opposite end. Both stirrups being raised to commence the operation, the upper funnel is filled as high as the top of the Tantalus syphon, and therefore discharges itself into the filter. The filter, then, with the weight thrown upon it, turns the scale and cuts off the supply, just as in the simpler apparatus. It will be seen that if the stirrup, *k*, completely closed the elastic tube on the emptying of the upper funnel the operation would come to a standstill after the first delivery; and to avoid this a small screw, *l*, is introduced to prevent the weighted end of the board swinging back to its full extent, so that when the filter is emptied and opens the tube at *f*, a slow stream commences to pour into the funnel *i*, increasing in rapidity as the augmented weight raises the wire at *k*.

It is scarcely necessary to explain the principle of the Tantalus syphon—a contrivance familiar to many as the basis of a philosophical toy. It consists of a bent tube like a U, with one arm longer than the other. The longer arm is fitted into the tube of a funnel by means of an india-rubber washer. Its syphon action is brought into play directly the fluid in the funnel has risen above the level of the top of the bend, and it then draws off the contents as far as its shorter arm reaches. The figures will explain the rest.

The application of the principle to the large filters used for manufacturing purposes will naturally suggest itself, and though the model exhibited was made for analytical purposes on a small scale, there is no reason that modifications to suit any variety of circumstances should not be introduced.

The simpler form of apparatus is in regular use in one or two laboratories for filtering solutions. A multitude of cases occur to the pharmaceutist in which it is desirable that his filter should never run too low, as in the separation of essential oils from distilled waters, and in such as these its employment would be of great advantage.

The arrangement was designed by Mr. W. Rennoldson, of Newcastle, and the model shown was lent by Mr. A. Freire-Marreco, Reader in Chemistry in Durham University, who has since presented it to the Museum of the Pharmaceutical Society at Bloomsbury Square.—*Pharmaceutical Journal.*

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Continued from page 200.)

Constructions of Dietaries: Preparation and Culinary Treatment of Foods.

THE construction of dietaries involves a variety of considerations, as—1st. The determination of the real wants of the body under different circumstances of age, sex, constitution, labour, and climate; 2nd. A proper selection of food, as regards quality, nutritive power, appetising property, digestibility, and price; 3rd. The association of foods in such wise as not to offend the appetite or burden the digestive powers; 4th. A right treatment of them by cooking &c., so as to render them most useful to the system; and 5th. A just distribution of the daily diet in appropriate meals.

As regards the first question—viz., the determination of the actual dietetical wants of the body—it may be answered from two sets of facts, as those which pertain to the minimum quantities of food capable of being used without loss of health or bodily vigour, and those which relate to the amounts of carbon and nitrogen exhaled from the body during different conditions of life.

In a general way it may be said that a healthy vigorous man consumes from 700 to 800 lbs. of solid food (dry) in a year. This amounts to about 2 lbs. of dry solid matter daily; and the quantity of water (free and combined) is about 5½ lbs. daily.

Pursuing the inquiry a little farther, we find that a man cannot live on a punishment prison diet of 1 lb. of bread a day with water, for in three days he will lose about 3 lbs. in weight, and will show signs of commencing starvation. This diet contains 1·3 ozs. of nitrogenous matter and 8·42 of carbonaceous (= 1,995 grains of carbon and 90 of nitrogen). Even the poor needle-women of London can only just exist, in a state of feeble vitality, with an average diet of 1¼ lbs. of bread a day, with about 1 oz. of dripping. This contains nearly 2 ozs. of nitrogenous matter, and 14·65 of carbonaceous, calculated as starch (=3,271 grains of carbon and 135 of nitrogen). And in military prisons, where as much as 3·8 ozs. of nitrogenous food, and 22·2 ozs. of carbonaceous (=6,925 grains of carbon and 256 of nitrogen), are supplied daily to prisoners for short terms of confinement, they frequently lose weight and give evidence of decay; so that for longer periods of imprisonment it is found necessary to increase the diet to 4·7 ozs. of plastic matter and 27·8 of respiratory (=8,647 grains of carbon, and 317 of nitrogen); in fact, according to Dr. Christison, the men confined in the prison at Perth cannot even do the work of pumping the water for the prison on a daily diet of 6 ozs. of plastic matter, and 25 of respiratory (=7,239 grains of carbon and 405 of nitrogen).

Again, Dr. Edward Smith found in his inquiries into the dietaries of adult male operatives of Lancashire and Cheshire, during the cotton famine, and also into those of the low-fed operatives of England, that the daily amount of food, only barely sufficient for existence, must contain 2·84 ozs. of nitrogenous matter, and 19·25 of carbonaceous (=4,300 grains of carbon and 200 of nitrogen). These are contained in 2 lbs. 3 ozs. of bread, which is regarded as a famine diet. The farm labourers of England consume daily an average of 3·18 ozs. of plastic matter and 26·01 of respiratory. In Scotland, Wales, and Ireland, the amounts are somewhat larger, as will be apparent from this diagram:—

AVERAGE DAILY DIET OF FARM-LABOURERS IN THE UNITED KINGDOM.

	Dry Nitrogenous matter. ozs.	Dry Carbonaceous matter. ozs.		Carbon. grs.	Nitrogen. grs.
In England	3·18	26·01	=	5810	228
In Wales......	4·12	31·22	=	6901	290
In Scotland....	4·76	31·34	=	6297	335
In Ireland......	4·94	28·73	=	6195	348
Average of all..	4·25	29·07	=	6477	300

These are the results of inquiries into the dietaries of many hundreds of families, the results being computed as for adults; but it is very probable, as Dr. Smith remarks, that the nourishment obtained by the labourer himself is somewhat above the average. This, in fact, is confirmed by the more extensive investigations of Dr. Lyon Playfair, who concludes, from a large series of observations, that the following may be regarded as the average proportions of the several constituents of food in the daily dietary of an adult man under different circumstances of existence:—

DAILY DIETS FOR	Flesh-former. ozs.	Fat. ozs.	Starch and Sugar. ozs.		Nitrogenous. ozs.		Carbonaceous calculated as starch. ozs.
Subsistence only ..	2·0	0·5	12·0	=	2·0	+	13·2
Quietude..........	2·5	1·0	42·0	=	2·5	+	14·4
Moderate exercise..	4·2	1·8	18·7	=	4·2	+	22·0
Active labour......	5·5	2·5	20·0	=	5·5	+	26·0
Hard work........	6·5	2·5	20·0	=	6·5	+	26·0

These conclusions accord pretty well with the determinations of Pettenkofer and Voit, who say that an adult requires daily, when at work, 5·22 ozs. of nitrogenous matter and 22·38 of carbonaceous (calculated as starch). Taking, therefore, the mean of all these researches, it may be said that a man requires daily the following amounts of carbonaceous and nitrogenous matter for idleness, for ordinary labour, and for active labour:—

DAILY DIETS FOR	Nitrogenous. ozs.	Carbonaceous. ozs.		Carbon. grs.	Nitrogen. grs.
Idleness............	2·67	16·83	=	3,856	187
Ordinary labour	4·56	24·48		5,757	319
Active labour	5·81	24·31		5,837	400

By pursuing the second method of inquiry, and estimating the wants of the body from the amounts of carbon and nitrogen exhaled and secreted, it is found that the proportion of carbon evolved as carbonic acid from the lungs of a man in health varies from 6 ozs. to 13½ ozs. daily, the difference being dependent on temperature, exercise, &c. Dr. Edward Smith says that it amounts to—

7·85 ozs. daily while the body is quiet;
9·11 ozs. do. with moderate exercise;
12·9 ozs. do. with considerable labour.

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* The Cantor Lectures, delivered before the Society of Arts.

And he considers that a healthy man of average weight (150 lbs.) emits 8·57 ozs. of carbon from his lungs daily. This, added to the quantity discharged from the skin and bowels, is not less than 9·6 ozs. daily (=4,200 grains) or just 28 grains per lb. of the man's weight. During light labour, he says it ranges from 9·6 ozs. to 10·5, and during hard work from 12·5 to 14 ozs.

The amount of nitrogen excreted as urea, &c., in the urine is also subject to great variation, according to the diet and exercise. Dr. Parkes found, in his experiments on two soldiers, that with an ordinary diet and no exercise it amounted to 2·03 grains per lb. weight of the body (=304 grains per 150 lbs.); and that with a non-nitrogenous diet and no exercise it was 0·95 grains per lb. weight (=142 grains per 150 lbs.); and with the same diet and active exercise it was 2·42 grains per lb. weight (=364 grains per 150 lbs.)

Professors Fick and Wislicenus observed that the nitrogen secreted during an ordinary diet and no exercise was at the rate of 1·53 grains per lb. weight (=203 grains per 150 lbs.); and that it fell to a little less than 1 grain per lb. weight with a non-nitrogenous diet during the labour of ascending the Faulhorn.

The researches of the Rev. Dr. Haughton, of Dublin, have led him to conclude that an average size man, performing routine work, secretes 187 grains of nitrogen as urea daily (=1·25 grains per lb. weight); and Dr. Edward Smith has estimated it at from 0·93 to 1·4 grains per lb. weight—a fair average being 1·15 (=173 grains per 150 lbs.)

The more extensive inquiries of Playfair, Ranke, Beigel, Moos, Vogel, and others, give a daily average of 171 grains of nitrogen as urea for a healthy man at rest, and 252 grains for ordinary labour.

It may therefore be safely concluded that with an ordinary diet an average size man excretes daily as urea 175 grains of nitrogen; and during labour of a moderate description it amounts to about 250 grains. Adding to these the proportions of nitrogen excreted in other forms in the urine, and the quantities passed from the bowels, the total amounts are probably about 190 grains while at rest, and 300 grains when at routine work; the difference, perhaps, being more dependent on the food than on the metamorphosed tissues of the body.

It thus appears that the proportions of carbon and nitrogen excreted correspond very closely with those contained in the diets which experience has proved to be necessary for man's sustenance; for when the results are put into a tabular form they stand thus:—

DAILY REQUIREMENTS OF THE BODY.

		Nitrogenous Food.	Carbonaceous Food.	Carbon.	Nitrogen.
		ozs.	ozs.	grs.	grs.
During idleness as determined	By dietaries	2·67	16·83 =	3,856	187
	By excretions	2·78	18·47 =	4,200	190
	Average ..	2·72	17·65 =	4,028	188
Routine work as determined	By dietaries	4·56	24·48 =	5,757	319
	By excretions	4·39	19·80 =	4,813	300
	Average ..	4·48	22·14 =	5,285	310

The first of these averages is represented by 2 lbs. 2 ozs. of bread, and the second by about 3½ lbs.

It appears also that the relation of the nitrogenous to the carbonaceous constituents of food should be about as 1 to 5½ or 6. These, in fact, are the proportions which Messrs. Lawes and Gilbert found to be best suited for fattening pigs. In milk the proportions are as 1 to 3·6 (the butter being calculated as starch); and no doubt these are the right proportions for the dietaries of children. Again, it will be observed that the relation of nitrogen to carbon is nearly as 1 to 19; whereas in milk it is about as 1 to 11. Referring to table No. 4 (p. 80), it will be noticed that the proportions in bread are as 1 to 22, and in meat as 1 to 13, showing that the former requires the addition of plastic matter, and the latter of respiratory.

In preparing dietaries, however, it will be best to take a rather liberal view of the question, and, therefore, I shall adopt the conclusions of Dr. Edward Smith—that even in periods of idleness a man's daily food should contain not less than 4,300 grains of carbon, with 200 of nitrogen; and a woman's at least 3,900 grains of carbon, with 180 of nitrogen—these being the proportions which, in his opinion, are necessary to avert starvation diseases; and they are represented in the case of a man's diet by 19·25 ozs. of carbonaceous food, with 2·84 of nitrogenous. The diagram before you exhibits the amounts of different articles of diet capable of furnishing this quantity of nitrogenous matter, and it also shows the proportions of carbonaceous matter (calculated as starch) associated with it:—

AMOUNTS OF FOOD YIELDING 200 GRAINS OF NITROGEN OR 2·84 OZS. OF PLASTIC MATTER NECESSARY FOR A MAN'S DAILY DIET.

Description of Food.		Carbonaceous matter in it.	Carbon in it.	
	ozs.	ozs.	grs.	
Skim-cheese	8·8	5·57	1,290	Carbon deficient.
White fish	24·6	5·99	1,384	
Skim-milk	94·1	8·96	2,059	
Peas	12·6	9·33	2,141	
New milk	91·4	9·40	2,160	
Lean meat	18·3	11·36	2,629	
Oatmeal	22·9	17·54	4,000	
Wheat-flour	26·7	19·28	4,433	Carbon in excess.
Baker's bread..	35·6	19·28	4,433	
Indian meal	26·0	19·83	4,554	
Rye-meal	36·4	26·40	6,046	
Barley-meal	45·7	34·02	7,800	
Rice	45·7	34·02	7,800	
Bacon	32·6	38·04	8,714	

So that, whilst the first seven of these substances are deficient of carbonaceous matter (19·25 ozs. being required), the last seven contain it in excess. It is therefore not difficult to construct a dietary from the several tables which I have placed before you; but perhaps it would interest you to know exactly what are the actual dietaries in use among different classes of persons; and first I will direct your attention to what Dr. Edward Smith found to be the average weekly dietaries of the low-fed operatives of England, Wales, Scotland, and Ireland. (See table at top of next page).

You will see from this table that the poor needlewomen of London are the worst fed of all the operatives in the three kingdoms, for they subsist on a weekly allowance of 102·52 ozs. of carbonaceous food, with 13·49 ozs. of nitrogenous (= 14·65 ozs. carbonaceous, with 1·93 ozs. nitrogenous daily), while the farm labourers of Ireland are, as regards the real nutritive value of their food, the best-fed of the lower operative classes. But it will also be noticed that the cost of the weekly dietary of the Irish labourer is only 1s. 9¾d. per week, while that of the needlewoman is 2s. 7d.—the latter feeding chiefly on bread, bacon, and tea, which are expensive foods, while the former consumes potatoes, milk, and Indian meal—foods which yield more nutriment for their money value than the more expensive foods of the English, Welsh, and Scotch labourers. And now we will contrast the dietaries of the poorer classes of operatives with those of better-fed persons, as soldiers, sailors, navigators, &c.;

Weekly Dietaries of Low-fed Operatives calculated as Adults (Dr. E. Smith).

Class of Labourer.	Bread stuffs.	Pota-toes.	Sugars.	Fats.	Meat.	Milk.	Cheese.	Tea.	Containing		Cost.	
									Carbon.	Nitro-gen.		
	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Grs.	Grs.	s.	d.
Needle-women (London)	124·0	40·0	7·3	4·5	16·3	7·0	0·5	1·3	22.900	950	2	7
Silk-weavers (Coventry)	166·5	33·7	8·5	3·6	5·3	11·6	1·0	0·3	27,028	1,104	1	11¾
Do. do. (London)	158·4	43·8	8·8	5·5	11·9	4·3	0·3	0·6	48,288	1,165	2	8¾
Do. do. (Macclesfield)	138·8	26·6	6·3	3·4	3·2	41·9	0·9	0·3	27.346	1,177	1	8¼
Kid glovers (Yeovil)	140·0	84·0	4·3	7·1	18·3	18·3	10·0	0·9	28,623	1,213	2	9¼
Cotton-spinners (Lancashire) ..	161·8	22·6	14·0	3·1	5·0	11·8	0·7	0·7	29,214	1,295	2	3
Hose-weavers (Derbyshire)	190·4	64·0	11·0	3·9	11·9	25·0	2·2	0·4	33.537	1,316	2	6¼
Shoemakers (Coventry)	179·8	56·0	10·0	5·8	15·8	18·0	3·3	0·8	31,700	1,332	2	7¾
Farm labourer (England)	196·0	96·0	7·4	5·5	16·0	32·0	5·5	0·5	40,673	1,594	3	0
Do. do. (Wales)	224·0	138·7	7·5	5·9	10·0	85·0	9·8	0·5	48,354	2,031	3	5¼
Do. do. (Scotland)	204·0	204·0	5·8	4·0	10·3	124·8	2·5	0·7	48,980	2,348	3	3¾
Do. do. (Ireland)	326·4	92·0	4·8	1·3	4·5	135·0	—	0·3	43,366	2,434	1	9¾
Mean of all	184·2	78·1	8·0	4·5	10·7	42·9	3·1	0·6	34,167	1,500	2	7¾
Average per day	26·3	11·1	1·4	0·6	1·5	6·1	0·4	0·1	4,881	214	0	4¼

and for this purpose I shall avail myself of the accurate returns obtained and published by Dr. Lyon Playfair:—

Daily Dietaries of Well-fed Operatives (Playfair).

Class of Labourer.	Flesh-former.	Fats.	Starch and Sugar.	Containing		Containing	
				Carbonaceous.	Nitrogenous.	Carbon.	Nitrogen.
	ozs.	ozs.	ozs.	ozs.	ozs.	grs.	grs.
Fully-fed tailors	4·61	1·37	18·47	21·64	4·61	5,136	325
Soldiers in peace	4·22	1·85	18·69	22·06	4·22	5,246	297
Royal Engineers (work)	5·08	2·91	22·22	29·38	5·08	6,404	358
Soldiers in war	5·41	2·41	27·92	23·48	5·41	5,561	381
English sailor	5·00	2·57	14·39	20·40	5·00	4,834	252
French ditto	5·74	1·32	23·60	26·70	5·74	6,379	405
Hard-worked weavers	5·33	1·53	21·89	25·42	5·33	6,020	375
English navvy (Crimea)	5·73	3·27	13·21	21·06	5·73	5,014	404
English navvy (railway)	6·8	3·82	27·81	37·08	6·84	8,295	482
Blacksmiths	6·20	2·50	23·50	29·50	6·20	6,864	437
Prize-fighters training	9·80	3·10	3·27	10·70	9·80	4,366	690
Mean of all	5·81	2·42	18·63	24·31	5·81	5,837	400
Do. of low-fed operatives	3·04	0·641	21·18	22·78	3·04	4,881	214

In all these cases the carbonaceous matters of the food are estimated as starch; and I may state that the soldiers' dietary, when at peace, is calculated from the rations of the English, French, Prussian, and Austrian service; and when at war, it is derived from the actual dietaries of European and American soldiers during recent wars.

It would be interesting, if time permitted, to compare these dietaries with the dietaries of hospitals, prisons, workhouses, and lunatic asylums; for we should then perceive not merely how greatly they vary in their nutritive value, but also how little attention is paid to the principles which ought to guide our public authorities in the construction of public dietaries. In the prisons of England, Scotland, and Ireland, the several dietaries for short terms of imprisonment, as well as for longer periods, and for hard labour, vary respectively to so great an extent as to furnish an inducement for the commission of crime in certain districts rather than in others, because of the richness of the prison rations; and in all cases the dietaries of prisons are so greatly in excess of those of the union, that in times of distress they offer encouragement for misdemeanour, in order that the prison may be reached in preference to the workhouse; in short, while the day's rations of an unfortunate inmate of a union contains only about 17 ozs. of dry nutritious matter, that of a destitute debtor contains 19·4 ozs., and that of a convict 22 ozs.; moreover, a prisoner confined for more than a month, without hard labour, in the gaols of England, Scotland, and Ireland, would have 18·8 ozs., 22·4, and 23·9 of dry nutriment respectively; the average rations for hard work containing about 21·7 ozs., 31·5, and 25·6 in the prisons of the three countries.

Dr. Edward Smith has drawn attention to the serious want of uniformity in the dietaries of the unions of his district, and has urged the workhouse authorities to improve them. He also submitted to the Privy Council tables of dietaries, which are well suited to meet the requirements of the system at the lowest money cost. Here are a few of them, which may, perhaps, prove useful to those who are engaged in the benevolent work of supplying food to the poor in times of distress; and you will perceive that at various sums, from about 2s. to 3s. a-week per adult, very substantial rations may be provided. (See table at top of next page).

The dietaries of women should be about 1-10th less than those of men in the case of indoor operatives, but they ought to be from 1-3rd to 1-4th less than the larger dietaries of men engaged in out-door labour.

As regards the dietaries of children, it may be stated generally that the chief part of their food should be milk. Up to the age of nine or ten months it should, if possible, be the milk of woman, which is richer in sugar than cow's milk, and much less rich in caseine; failing this, however, asses' milk is a good substitute, as it contains nearly the same amount of sugar and caseine as human milk. MM. O. Henri and Chevalier have given these as the proportions of the several constituents in 100 parts of the milk of different animals:—

	Asses' milk.	Woman's milk.	Cow's milk.	Goat's milk.	Ewe's milk.
Caseine	1·81	1·52	4·48	4·02	4·50
Butter	0·11	3·55	3·13	3·32	4·20
Sugar of milk	6·08	6·50	4·77	5·28	5·00
Various salts	0·34	0·45	0·60	0·58	0·68
Total solids	8·34	12·02	12·98	13·20	14·38
Water	91·66	87·98	87·02	86·80	85·62
Total	100·00	100·00	100·00	100·00	100·00

Cow's milk, therefore, diluted with about one-third its bulk of water, and sweetened with sugar, may be given to children; and up to nine or ten months no other food should be administered, for infants have not the power of digesting farinaceous or fibrinous substances. A child may take from two to three pints of milk thus diluted daily. After ten months, and to about twenty months, farinaceous matters may be mixed in gradually increasing quantities with the milk; and they should be well cooked by first

DIETARIES TO FURNISH AS NEARLY AS POSSIBLE 30,100 GRAINS OF CARBON AND 1,400 GRAINS OF NITROGEN PER MAN WEEKLY—WOMEN TAKE ONE-TENTH LESS.

Cost.		1s. 11¾d.	2s. 0½d.	2s. 3½d.	2s. 4½d.	2s. 6d.	2s. 7½d.	2s. 8½d.	2s. 10½d.	3s. 1½d.	3s. 3½d.
		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.
Bread		144	128	160	160	128	160	160	160	192	160
Flour for dumplings		—	—	—	—	—	—	—	16	16	8
Oatmeal		16	32	16	32	32	16	16	16	—	8
Peas		—	—	—	—	12	6	—	—	—	—
Rice		—	—	16	—	—	—	16	—	8	8
Sugar		—	4	4	—	4	4	4	4	8	8
Treacle		—	16	8	8	8	—	8	12	8	8
Butter		—	—	—	—	2	—	—	2	—	12
Dripping		—	—	4	—	—	4	4	—	4	—
Suet		—	—	—	—	—	—	—	4	4	2
Meat without bone		8	8	—	8	8	8	16	12	8	24
Herrings		—	—	—	—	4	—	—	—	—	—
Bacon		—	—	—	8	4	8	—	—	8	—
Skimmed milk		70	140	60	70	120	120	70	120	70	100
Buttermilk		60	—	80	—	—	—	60	—	60	—
Tea		—	—	—	—	—	0·5	—	—	0·5	0·5
Coffee and chicory		—	2	2	—	1	1	2	2	1	1
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.
Nutritive values	Carbon	28,031	29,748	33.552	34,935	32,998	33,248	36,499	36,402	41,519	36.391
	Nitrogen	1,409	1,291	1,511	1,548	1,859	1,609	1,674	1,638	1,768	1,620

baking them, and then thoroughly dissolving them by boiling. After this age, and up to the third year, the quantity of well-cooked farinaceous matters may be still further increased, and given as puddings with a little egg. Bread and butter may also be eaten, and towards the end of the time the child will digest well-boiled potato, with a little gravy of meat. From the third to the fifth year a little meat may also be given, and at the end of the ninth year it may partake of the usual food of the family; but all along it should make use of a large proportion of milk, in the various forms of bread and milk, or milk puddings with eggs. About the tenth year a child will require about half as much food as a woman; and at the fourteenth year it will eat quite as much as a woman; in fact, the proportion of food required by the child is much greater per pound weight of the body than that of adults, because it has to form its tissues and build up its several structures. Dr. Edward Smith calculates that the proportions of carbon and nitrogen in the daily food at different ages should be about as follows:—

DAILY PROPORTIONS OF CARBON AND NITROGEN IN THE FOOD AT DIFFERENT AGES, PER POUND WEIGHT OF THE BODY.

	Carbon.	Nitrogen.
	grs.	grs.
In infancy	69	6·78
At ten years of age	48	2·81
At sixteen do. do.	30	2·16
At adult life	23	1·04
In middle age	25	1·13

So that for its weight the infant requires three times as much carbonaceous food and six times as much nitrogenous as an adult.

(To be continued.)

Danger Arising from the Exhalations of some kind of Fruit.—It is a well known fact that the perfume of some kinds of flowers is injurious to health, and even cause death, if flowers are kept in a confined space frequented by men at the same time. One of the local papers of the city of Lyons now records the fact of death by asphyxia, suffered by a lady who slept in a room wherein a large quantity of quinces were kept; according to scientific evidence, given in this instance, the air of the room was largely vitiated with a peculiarly suffocating perfume, and a very considerable amount of both carbonic acid and carbonic oxide gas. The room in question was always used as a bed room; no fire had been lighted in it, nor was any other discernible cause for the death of this lady found but the exhalations of the fruit.

NOTICES OF BOOKS.

A Sketch of a Philosophy. Part II., Matter and Molecular Morphology. Williams and Norgate, Covent Garden.

OCCASIONALLY remarkable works fall to the lot of a reviewer; of this class is the work before us. That this statement is true, the reader would find sufficient evidence in the first few lines of the author's introduction, styled "A Hint of our Philosophy."

In the actual state of science we are told the phenomena of nature have been classified to a great extent and referred to laws, but these laws are numerous, and the acquisition of science accordingly laborious. "Most of them (the laws) also rest solely on an inductive or empyrical basis; they have been reached merely by observation, they give no account of themselves to Reason; and this places them in a very unsatisfactory position in an intellectual point of view." That the inductive method of arriving at a law of nature is the one to which least objection can be raised, we are assured all physicists and chemists will maintain. Continuing the paragraph, we find "It obliges the man of science to content himself with intellectual despair as the only kind of intellectual repose which the actual state of science allows him." This statement, to say the least of it, rather startles the man of science; he tries to imagine exactly what sort of feeling intellectual despair is.

The author remarks that some years ago he endeavoured to show that there is one general mode of action, which, when modified according to circumstances, gives all those varied modes of action which are usually regarded as laws of nature, but he did not then see the reason of the law.

The first law is the cosmical or all-embracing law. This law is named from that operation of it, which is most important to us, "that by which our organisation is redintegrated and our energy maintained from hour to hour, namely, assimilation. And the reason of it appears on our considering the consequence of that view of nature which has already been alluded to, namely, that nature in the creation of an all-sufficient Creator—a view which may certainly be characterised as the most natural as well as the most respectable." But the author finds it convenient, by reason of our intellectual weakness and shortness of life, to have a number of laws to refer to rather than one only. The all-embracing law is therefore resolved into three, and these into two sets; the two sets take their rise in the twofold fact that the finite assimilates itself on the one hand to the infinite, and on the other hand to itself. Probably the connection between the words finite and infinite suggested the first portion of the twofold fact to the author. From the assimilation of the finite to the infinite arise the law of diffusion or expansion on the one hand, and the law of individuation or condensation on the other, and as their harmonised product in the material economy the law of the perfect in form (symmetry culminating in sphericity). From the assimilation of finite objects to one another arise the law of the permanence of the properties of matter and the law of types or species on the one hand, and the phenomena of affinity and transformation and the law of generic resemblance on the other; and as their harmonised product the law of the conservation of energy. What can anyone, not upon a par with the author in intellectual capacity, make of this conclusion. "Theodicy and our theory therefore equally suggest a creation which shall consist wholly of spiritual, psychical, or sentient Beings?" We remember Mr. Punch quietly making a note of the use of the expression *sapient* act by a journalist, what would he say to the term *psychical* beings? The indiscriminate way in which capitals are used for being and infinite is very confusing.

This assertion will be read with interest, "these are our two 'elements' *par excellence*; hydrogen being that into which a world now dissolving tends to be resolved, as also that which is the seminal element of a new world, and thus that which connects two cycles; while azote comes out in our theory as a residuum." Illustrations of the various forms of the molecules of elements and their compounds are given; they represent symmetrical figures of great beauty. For the purpose of illustrating the doctrine of molecules, the substance sugar is taken. And here we quote in reference to this, a number of statements that we consider altogether unjustifiable, and that are certainly obnoxious to chemists, since evidently made by one possessed of a very superficial knowledge of chemical science. "Its formula in chemical works is . . . . . . $C_{24}H_{22}O_{22}$ (in the notation of the classical epoch of Prout, &c., when $C=6$ and $O=8$), and its specific gravity has been found 1·56—2·6. Why the specific gravity should be this rather than anything else, why CHO should only be insulable as C_{12}, &c., and C_{24}, &c., are it must be admitted perfect mysteries by all the light which the most advanced chemistry can throw upon such subjects."

The author, our readers have seen, prefers to use the term azote for nitrogen, likewise he prefers to use silicia for silica, and to represent part of the formula of sugar, $C_{12}H_{10}O_{10}$ by Su. The two terms supplied by chemistry, atom and molecule, are also insufficient for the division of bodies; we might however add that a third one, namely mole, has already been suggested (Hofmann's Mod. Chem.) So the word molecule is cut up, and thus are obtained *ule* or atom, an undecomposable element, *cule* a first combination of atoms, *moleule* a group of ules or cules, *molecule* the aggregate which is in relation with AQ the unit volume of liquids and solids, and *mole* or mass, the visible palpable object. We must explain that $AQ=aq_{36}$ is a particle or unit volume of water. It is stated that the views before enunciated imply that a system of molecular morphology in order to be truly scientific ought to begin with baric and barytic substances for in the theory these are, as it were, mineral embryos "though for their full development (blessed creatures!) they require no food, but heat only."

After reference to the water type in modern chemistry and the number of compounds constructed upon this type, another modest statement occurs. "Hence a maze of formulæ which have no response in nature, and indeed no value beyond the walls of the laboratory in which the relative experiments are conducted, or the mind of the chemist who enjoys the privilege of being their creator, or of having mastered the difficulty of conceiving what they mean, or of putting the letters in their right places upon paper." Accordingly we are told the numbers who take an interest in scientific chemistry now compared with what they were half a century ago are very small (?). One might add that if learners had for theory only our author's work to refer to, in another half century chemists would be working out the laws of their science by the inductive process. As an example of the terms in which other theorists' views are referred to, the following serves well: "Meanwhile physicists are proposing another theory of the constitution of aëriforms—a sort of emanation theory in bottles—a game at gas billiards—which reduces the whole to chaos."

In conclusion, we think it possible to show that the author has, at any rate, as far as chemistry is concerned, very cleverly worked out the *reductio ad absurdum* for his theory. "Thus, suppose we were set out with baric and barytic combinations, a normal telluride or a sesquiselenide of tungsten, for instance, and to develope them into elements of common weight, observing the laws of morphology while doing so, we should obtain as the result of the development, molybdenite, magnesia, manganese, iron, and lead, along with tungstic and molybdic ochres." Evidently the philosopher is aware that he is an advanced thinker—in a word, a man before his time—for he adds, "but such developments belong to an advanced state of our science, of which the alphabet, alas! is more than most people will consent to learn at present."

CORRESPONDENCE.

ARTIFICIAL MANURE.

To the Editor of the Chemical News.

Sir,—I know of no branch of the public press that could render such important service at this moment to the science and practice of agriculture as that over which you preside, if you could only spare a small portion of your valuable space for the purpose of eliciting a sound opinion on the proper choice, qualities, and purchase of artificial manure. I will, therefore, with your permission, address the following observations

To the Chemists of Great Britain.

Gentlemen,—"I take the liberty of addressing to you a request of the greatest importance to the progress of agriculture in this country, and my excuse for taking this liberty is that any opinion in reference to the science of agriculture that bears the sanction of your authority will be accepted by farmers and others, as not only of the highest order, but in the most perfect faith of its being given sincerely and purely in the interest of agriculture.

"The request I have to make to you—not alone in my own name, but in the name of an association formed to protect and promote agriculture—is that you will favour us with your opinion on the principles we have adopted in the choice and purchase of artificial manure.

"In this country the trade and manufacture of artificial manure is assuming gigantic proportions. At certain seasons of the year our corn exchanges are inundated with makers and their agents; every kind of "specific" in the shape of manure is offered for sale by all sorts of people and for every kind of crop; and I need scarcely inform you that, in proportion as these artificial manures are good and useful, so are they associated with an alarming amount of deception and fraud; so much so, indeed, that, unless some very active measures are taken to expose and counteract this evil, the employment of the good and useful manures will be seriously affected, and the progress of agriculture seriously checked.

"We are doing all we can to meet this large and growing evil, by the formation of an association of practical farmers, and hope by combined effort to secure to agriculture all the advantages that science has bestowed upon it, and at the same time protect ourselves against the various costly and comparatively useless 'nostrums' and fraudulent mixtures that are prepared by mean and insignificant makers under the various titles given to artificial manures.

"That an association such as we have formed was most urgently required will be seen by the following facts:—Only a few months ago I was paying to a most respectable firm £6 10s. per ton for manure, which I am now able to purchase, of even better quality, at £4 2s. 6d.; but this reduction in the cost of manure is not, after all, the most important fact. It is still more satisfactory to know that, at all times, we may rest assured that through the watchful agency of our association any manure received will certainly have the quality and strength bargained for. Just to show the great change and progress that have been made in the manufacture and supply of phosphatic manures within a few years, I will quote from a card which gives the analysis and value of manure as supplied by one of the most honourable and respectable manufacturing firms. This manure was stated by six eminent chemists to contain an average of 18 per cent of soluble phosphate, and was valued at between £9 and £10 per ton. Now by the rule of three, if 18 per cent costs £10, the value of the manure as now supplied through our association, and containing 26 per cent, should be something over £14 per ton; again, the value of soluble phosphate was estimated at £35 per ton; at this moment, the pure soluble phosphate contained in our manure and delivered free to our members costs about *twelve pounds* per ton; but is it unreasonable to expect a still further reduction in the price, and improvement in the quality of these manures? Hitherto the great source from which our phosphatic manures have been procured has been the wonderful coprolite beds of Cambridgeshire, Bedfordshire, Suffolk, &c.; but recently there has been discovered phosphatic rocks in Spain and Canada, containing not less than 80 per cent of phosphate of lime. Surely it is only a question of time when these immense stores of phosphorus will be imported into this country in quantities without limit, and thus enable us to restore, not only to our arable soils, but to our grass lands as well, the phosphatic elements which for so many years have been taken from them, and which I have no doubt has been one of the chief causes of the exhaustion of our soils; and is it not probable that this immense trade will shortly fall into the hands of our large sulphuric acid makers, who will use these minerals as a convenient means for disposing of thousands of tons of sulphuric acid.

"An important principle in the conduct of our association is this,—no exclusive or individual interest or profit can exist; whatever advantage we can secure by co-operation is entirely for the benefit of the general body of our members. Another important principle is that we purchase only one kind of artificial manure—'Superphosphate of Lime;' and we do this in obedience to what we believe is nature's simple and beautiful law—Return to the soil in some shape that which you take from it. We say the crew yard with the food consumed by stock, together with a system of cultivation that enlarges and deepens the lungs of the soil, thus enabling it to inhale and more completely nourish itself by the action of rain and the atmosphere, will in general supply everything else that can be *profitably* employed. Consequently every shilling that a farmer has to spend in artificial manures is spent with the greatest advantage in the purchase of phosphatic manures only.

"We do not deny that 'special manures' may not be useful in 'special cases,' but such manures must always be expensive, since there can be no competition in their supply; each maker has his own secret or patented process, in neither of which have we any faith, therefore the cost of such mixtures to the consumer must be just what the maker may be inclined to charge; but we further protest against farmers purchasing or using at any time artificial manures, the composition of which they are completely ignorant, and by so doing put themselves blindly into the hands of the manure makers. Every farmer should know what he buys, and for what purpose; without this knowledge he is no longer a farmer, but simply an agent—the manure maker usurps the intelligence of the farmer; besides such a position at all times exposes the farmer to the grossest deceptions and frauds. These very serious objections cannot occur in the purchase of phosphatic manures; their composition is well understood, and a large amount of experience has proved the many ways in which they may be profitably employed; they are besides prepared by numerous makers, and are at all times under the control of the 'Golden Economic Law' of free competition—supply and demand. In the purchase of these manures the farmer knows exactly what he buys, and by becoming a member of an association such as we advocate, he ensures for himself a phosphatic manure of certified quantity at the very lowest cost.

"I hope that I have clearly explained the purpose of our association, in its chief principle, which we earnestly advocate, viz., the use and function of one kind of artificial manure. We believe we are only putting into practice the laws and opinions which have been long advocated in the many works and contributions to the science of agriculture. Should these observations be successful in eliciting the opinions of chemists, I hope they may be of a thoroughly practical character. It will be of no use to say certain materials would be valuable additions to the simple phosphatic manure unless they can be procured in any quantity and at prices that will make it worth while. Manure makers are too ready to talk of the absence of nitrogen or ammonia, potash, magnesia, &c.; but supposing these substances to be necessary or useful, can they be purchased to pay, and does not Nature supply the most important of them—nitrogen—free of all cost if man will only perform his part in the preparation of the soil? Do we not always find, when we read Nature aright, that all the large requirements for the sustention of vegetable and animal life is ever at hand? If this is not the case, why have we six million pounds of nitrogen constantly pressing on every acre of land? and why has the wonderful discoveries of the spectroscope revealed to us that the salts of the ocean, especially soda, is to be found everywhere, even on the tops of our highest mountains.

"In conclusion, allow me to observe that, should the objects of our association have the valuable support of your favourable opinion, it will then only remain for time, patience, and perseverance to complete our task and to make our association an example to be usefully and profitably followed by every other part of this great agricultural country."—I have the honour to be, Gentlemen, in the name of the South Lincoln Tillage Association, your obedient servant,

William Little.

Heckington Hall, Lincolnshire,
October, 1868.

Note.—I shall be glad to forward the rules and regulations of our association by post to any person who may require them.

A NEW SCIENTIFIC CLUB.

To the Editor of the Chemical News.

Sir,—If Mr. Lippincott would kindly charge himself with laying down a code of rules, he will greatly conduce to the desideratum of uniformity of observation as to ozone. I am glad to see his strong assertion of the value of this.

For several years it has been an idea of mine to associate myself with several other men interested in scientific questions, and, whilst each of us should more especially pursue his own branch—as mineralogy, geology, meteorology, botany, &c.—that we should all agree to work together, and all daily to make the same set of observations at different heights. I hope next year to develope this scheme.

With regard to the field of work, there are two plans which suggest themselves; either for one of us—and I volunteer—to reside several weeks at the summit of the pass of St. Theodule, 10,900 feet above the Mediterranean, and the highest point in Europe where a long stay would be practicable, whilst others among us observed at lower elevations; or, perhaps as good a plan, to use my own yacht, charged with instruments, for a scientific trip to Norway, and as our base of operations, taking a tent up to some well selected point of great elevation, or to several.

It is to be regretted that there is no *real* "Traveller's Club;" nor, unless the "Journal of Travel" should supply the hiatus, is there any periodical at which peripatetic philosophers would look to meet with proposed organisations, mutual requirements, and so forth.

I have found it almost impossible to hear privately of fellow labourers willing to organise a mutually aiding trip.

I appeal to you, Sir, to afford me this chance through your valuable columns; and, that any may write direct to me, besides the response I hope to see in the Chemical News, I enclose my card, and am, &c.,

"Per Mare per Terram."

October, 24, 1868.

MISCELLANEOUS.

Chemical Society.—The first meeting of this society will be held on Thursday evening next, November 5th, at eight o'clock.

The Science Lectureship at the City of London School.—At a recent meeting of the school committee, the post lately vacant by the resignation (through ill-health) of Mr. Thomas Hall, B.A., has been conferred upon Mr. Henry Durham, who for seven years past has assisted Mr. Hall in the duties of his appointment, and taken under his charge the junior division of the school.

Dr. Herapath, M.D., F.R.S., &c.—This eminent physician, chemist, microscopist, and botanist, who has been suffering from jaundice for some time, died at his residence in Bristol, on Monday, the 12th inst. The deceased was the eldest son of the late Mr. William Herapath, the well-known analyst. The doctor was a fellow of most of the leading learned societies, besides being the author of several papers of interest; one lately published, "On the Use of the Spectroscope and Microspectroscope in the Discovery of Blood-stains and Dissolved Blood," was greatly thought of by the profession.

The Fungus Theory of Disease.—In a short communication to the *Centralblatt*, Drs. Bergmann and Schmiedeberg describe a crystalline substance, to which they have applied the name "sulphate of sepsin," obtained from putrefying materials, and which they believe represents the proper poison of organic substances undergoing this kind of fermentation. It is obtained, says the *Lancet*, by diffusion through parchment paper, precipitation with corrosive sublimate from an alkaline solution, removal of the mercury by silver, of silver by sulphuretted hydrogen, evaporation, and purification of the residue. Large, well-defined, acicular needles are thus obtained, which are deliquescent in the air, and, exposed to heat, melt and carbonise. They possess a powerfully poisonous action. A solution containing scarcely more than one-hundredth of a gramme was injected into the veins of two dogs. Vomiting was immediately induced, and after a short time diarrhœa, which in the course of an hour became bloody. After nine hours the animals were killed, and on examination their stomachs and large intestines were found ecchymosed and the small intestine congested. Frogs could be killed in the same manner.

Baron Liebig's Advice in Respect to Bread Making.—It is a well known fact that the products of the ordinary fermentation of bread are carbonic acid, a portion of which is retained in the dough, and by its expansion on the sponge being submitted to the heat of the oven, renders the bread spongy; besides this, butyric acid and also alcohol are generated at the expense of a portion of the starch contained in the flour, a loss amounting to about from 2 to 4 per cent of the flour applied for bread making. The alcohol is irretrievably lost, and its loss is estimated by Liebig to amount for Germany to 50,000,000 of litres annually, and for London (the Metropolis), at 600,000 litres; all experiments tried to collect and condense this alcohol have turned out failures. Liebig recommends the following ingredients:—50 kilogrammes of rye meal, 500 grammes of bicarbonate of soda, 2·125 kilogrammes of pure hydrochloric acid, 2 kilogrammes of common salt, and 40 litres of water; the bicarbonate of soda and the acid yield carbonic acid gas, which renders the bread light and spongy. According to Liebig the following are the advantages of the use of this method above the old-fashioned fermentation process, 1st,—saving of time and material, since no alcohol or other by-products are formed. 2nd,—this bread does not readily become mouldy, since, not having been mixed with yeast, it does not contain, as is otherwise always the case, the sporules of cryptogamic plants which are the cause of mouldiness. The objection to the use of this bread by many people is its insipidity and want of a flavour the palate has from childhood become accustomed to. To mend this defect Liebig recommends the addition of from 4 to 8 litres of good vinegar upon 100 kilogrammes of flour, and to correspondingly decrease the quantity of water. When it is desired to give to this kind of bread the taste of soldier's bread, *pain de munition*, one should add to the dough and mix up with it 250 grammes of rather dry, not too rich, cheese. Liebig observes that at München bread is now largely made according to the plan described; it only takes four hours to convert a hundredweight of flour into bread. As will be readily observed by the majority of readers, Liebig's process is on the small scale. Dr. Dauglish's system, the celebrated German *savant* observes, has neither in Paris nor other French towns, taken at all well. The same applies to Belgium and Holland. Instead of rye meal, wheaten flour can be taken.

Water Supply and the Death Rate.—The inquiry which was made two or three years ago in consequence of an outbreak of cholera in the East of London proved, to the surprise of some of the men of science who took part in the investigation, that, after excluding the case of tainted wells, there was no assignable relation between the purity of water and the health of the consumers. The quality of water supplied to the West of London from the Thames, and to the Eastern half of the metropolis from the Lea and the New River, is, on an average, uniform. As the sources of supply in all cases are the chalk districts to the North and to the West, the water contains a considerable admixture of lime, and the total amount of solid matter is considerable. The analytic chemist, offended with the presence of alien substances, delights to contrast the water which the New River Company distributes in the City of London with the limpid produce of the Scotch granite or the millstone grit of Lancashire and Derbyshire. The typical water supply was proved some years since for Glasgow by Mr. Bateman; and the same skilful engineer has furnished Manchester, at an expense of more than a million sterling, with an almost equally pure supply stored from the rainfall on the ridge which feeds the Irwell and the Mersey. The natural reservoir of Loch Katrine discharges itself into the mains of Glasgow with a merely nominal admixture of two or three grains of solid matter in a gallon; and sanitary enthusiasts at Birmingham and elsewhere are in the habit of expatiating on the advantages which London would derive if an equally pure supply were provided from the Northern lakes, or from the upper waters of the Dee or the Wye. It unluckily happens that the death rate in London is comparatively low, and that in Glasgow and Manchester it is extraordinarily high. When the objection is raised, the water fanatics reply, with good reason, that there are many other causes besides the quality of water which affect health and life; but they forget that they have themselves undertaken to prove the connection between solid matter in water and disease. Sanitary pursuits produce a kind of intoxication which raises the intellect of a genuine theorist above the vulgar rules of induction. If an epidemic breaks out in London, the evil is at once attributed to the water, while it is assumed that Manchester and Glasgow would be even more unhealthy than at present but for the purity of their supply.—*Saturday Review.*

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Bulletin de la Société d'Encouragement.

May, 1868.

H. Bouilhet, "Report on J. Feuquière's Processes for the Electro-Deposition of Iron and Tin." Balard, "On E. Carré's new Sulphate of Copper Battery." "On E. Carré's new Regulator for the Electric Light."

June, 1868.

Moll, "Report on De Lagarde's Work on the Utilisation of certain Products as Manure." Chevallier, "On the Explosive Properties of Mittenzwey's 'Artificial Saffron'." De Luynes, "On Dubrunfaut's Method of Separating Salts from Molasses and Saccharine Solutions." Dumas, "On the same Subject." "On Hellriegel's Experiments on the Fertilising Properties of Manures containing a varying Quantity of Phosphates, Nitric Acid, and Potash." "On Klein's Method of Depositing Iron by Voltaic Electricity."

July, 1868.

Payen, "On Champonnois' new Method of Extracting Sugar." F. P. Le Roux, "Experiments on the Production of the Electric Light."

Dingler's *Polytechnisches Journal.*

August, 1868.

"On the Extraction of Silver from Lead by means of Zinc in the Upper Hartz." H. Gruneberg, "On the Extraction of Sulphate of Magnesia from the Impure Rocksalt of Stassfurt." E. F. Anthon, "Contributions to the Knowledge of the Manufacture of Sugar:—6. An Instructive Example of Diffusion. 8. On the Errors in the present Methods of Expressing the Results of an Analysis of Saccharine Products. 9. On the Specific Gravity of a Saturated Solution of Sugar at 14° R. 10. An Attempt to Devise a Process for Refining Raw Sugar without the Aid of Heat or Chemicals. 11. On the Formation of Oxalate of Lime during the Manufacture of Beet-root Sugar." A. Spirk, "On Extract of Madder, and on the Use of the same in Printing Fabrics." "On the Preparation of Aniline Black for Printing Fabrics."

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2923. H. J. B. Kendall, Great Winchester Street, London, "A new or improved preservative paint or composition for protecting ships' bottoms, preserving submarine wood work, and other useful purposes."—A communication from W. F. Babcock, San Francisco, California, U.S.A.—Petition recorded September 23, 1868.

2940. J. Baggs, High Holborn, Middlesex, "Improvements in making white lead, and in the means and appliances for performing the same."—September 25, 1868.

2962. G. F. Morant, Frenchay, Gloucestershire, "Improvements in the manufacture of artificial fuel."—September 26, 1868.

2968. C. D. Abel, Southampton Buildings, Chancery Lane, "Improvements in converting cast-iron into wrought-iron, and in uniting oxides and fluxes with molten cast iron."—A communication from T. S. Blair, Pittsburg, Penn., U.S.A.—September 28, 1868.

2996. W. E. Newton, Chancery Lane, "Improvements in treating metals for the purpose of separating from them various impurities or foreign substances."—A communication from N. Cutter, Cincinnati, Ohio, U.S.A.

2998. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of white lead, and the production of carbonic acid gas for the said manufacture and for other useful purposes."—A communication from H. Hannen, B. F. Pine, and T. Woods, Philadelphia, Penn., U.S.A.

3004. A. T. Becks, Birmingham, and G. Johnson, Aston, near Birmingham, "Improvements in the manufacture of rouge and polishing powders."—September 30, 1868.

3006. H. Highton, M.A., Brighton, Sussex, "Improvements in the manufacture of artificial stone and slate, and in colouring and preserving the same, part of which are also applicable to the preservation of walls and other surfaces."

3016. W. E. Newton, Chancery Lane, "An improved process for decorticating grain."—A communication from E. Weiss, Rue St. Sebastien, Paris.—October 1, 1868.

3026. C. E. Brooman, Fleet Street, London, "Improvements in the treatment of fatty matters in order to harden them and apply them to the manufacture of candles, soap, and other uses."—A communication from M. Paraf-Javal and E. Paraf-Javal, Thann, France.

3034. E. A. Cowper, Great George Street, Westminster, "Improvements in the manufacture of iron and steel, and in the apparatus and materials used for that purpose."—October 3, 1868.

3050. J. G. Willans, St. Stephen's Crescent, Middlesex, "Improvements in the manufacture of iron and steel."—October 6, 1868.

3119. N. Smith, Glasgow, N.B., "Improvements in treating and utilising waste acid liquors."—October 12, 1868.

NOTICES TO PROCEED.

1922. J. Gray and R. Weir, Glasgow, N.B., "Improvements in treating ores and in refining crude metals, in order to obtain steel, copper, tin, and lead, and in apparatus therefor."—Petition recorded June 12, 1868.

1932. C. Humfrey, Southwark, Surrey, "Improvement in the preparation of a flexible compound applicable to waterproofing and other purposes."—June 13, 1868.

2129. J. B. Brown, Walker, Northumberland, "Improvements in furnaces for calcining ores and other mineral substances."—July 3, 1868.

2356. F. Lambe, A. C. Sterry, Rotherhithe, Surrey, and J. Fordred, Blackheath, Kent, "Improvements in treating animal and vegetable oils, fats, fatty acids, wax, resins, essential oils, balsams, and the solid and liquid hydrocarbons."—July 27, 1868.

NOTES AND QUERIES.

Cashew Nut.—Can any of your readers tell me the composition of the volatile oil, and of the acrid principle in cashew or monkey nuts?—A. L.

Phthalic Acid.—Will anyone be kind enough to tell me by what method crude naphthalin can be converted into phthalic acid, and the proportions of ingredients? I know there is a process, but I don't know what it is.—Naphthalin.

Will the Sun put a Fire Out?—I am told by many persons, whose powers of observations are trustworthy enough, that the direct rays of the sun will check the flame of a burning fire, and even put it out altogether. I have never noticed the fact myself, but I find it is quite generally believed to be well founded. Has it ever come under *scientific* observation, and, if so, what is the cause assigned for this remarkable action?—G. L.

[The appearance is due to an optical illusion caused by the great flood of light shining on the coals and ash, and overpowering the feeble light of the flame and red-hot coals.—*Ed. C.N.*]

TO CORRESPONDENTS.

D. M. W.—1. We are not aware that solutions to the question have been published. 2. The author named has not written a book on "Practical Chemistry." See Professor Bloxam's "Chemistry."

J. C. Lee.—We are much obliged for the communication, and will take notice of the subject next week.

J. T.—Declined, with thanks.

W. Simpkin.—The best lubricator you can employ is a mixture of plumbago and tallow.

M. M. S.—Soak the sections of bone in caustic potash; this will remove the organic matter. Then well wash, and mount in Canada balsam.

Communications have been received from F. A. Favel; Marshall Hall; D. M. Edwards; W. W. Smyth (with enclosure); J. C. Lee; A. Liversidge; B. Sulman; A. E. Schmersahl and Co.; C. Guichenet; Dr. Röhrig; H. H. Watson; Dr. Muspratt, (with enclosure); Dr. Odling, F.R.S.; Dr. R. Angus Smith, F.R.S.; J. C. Brown; and Dr. R. Oxland.

BOOKS RECEIVED.

Notes on Metals, being a Second Series of Notes for the Lecture Room. By Thomas Wood, Ph.D., F.C.S. London: Longmans.

An Introductory Address Delivered at the Westminster Hospital. By Francis Mason, F.R.C.S. London: John Churchill and Sons.

Chemistry for Students. By Alexander W. Williamson, F.R.S., F.C.S., &c. New Edition. London: Macmillan.

The World of Wonders. Part I. London: Cassell, Petter and Galpin.

THE CHEMICAL NEWS.

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CHEMICAL LABORATORIES OR WORKSHOPS.

Liebig used to say that when he went to Giessen, he was put into a place like a gardener's tool house, and in that he was expected to make discoveries and prepare his lecture experiments. His influence was sufficient to procure a pleasant house, with a laboratory below and with several apartments; but his fame grew until that laboratory became small and trifling, and a mere place for rough work attached to that large and famous one which, like himself, attracted so many of all countries, and which especially brought him into connection with England and Englishmen. Now the fine new laboratory is small, whilst not many miles away one has arisen so far unlike a mere tool house that the Grand Duke himself might rejoice in the libraries, sitting rooms, halls, passages, and general aspect of the place, if he could not enjoy working in the bright and commodious student's apartments.

We all recognise that the world is moving fast, but whilst we do so generally some movements are taking place with such rapidity that we cannot observe until the work done has surpassed our hopes and sometimes our understanding. The God who made creation is explaining his works, and man who is made in his image is imitating the work of creation. We have lived without the knowledge of creation, and so far also of the Creator; but as this power becomes revealed to us in science, it begins both to delight and to awe us in regions which before seemed dark and empty. Scenery on the surface of the earth has long pleased us; as we go down we find new strata of delight. The influence of science on man's mind will increase, and we can only suppose that it will move forward as steadily and constantly as the earth itself. Already some men are so astonished at the magnitude of some of the parts that they believe that nothing else can be in existence, and so they have bowed down. They do right to worship the highest that they know, as a dog worships his master, even if he be but a beggar and a thief.

We may like or dislike the movement, although both feelings will be spent in vain. The knowledge of natural laws will enter into our minds so thoroughly, that private, social, and political life will be equally penetrated; but every one likely to read this knows it perfectly well, and why should it be repeated? Are even journals of science to tell us old tales instead of discoveries, and stultify their own prophesies regarding the progress of truth by telling us only the popular notions of the time? We would answer to the first part, "Yes; We fear they must do so." Although science will have much to do so in ruling the world, it is by no means certain that we, as individuals or as a nation, shall have its full benefit. In all great revolutions there are the conquerors and the conquered; the balloon moves calmly even in a storm. We had last year a great congress to discuss technical education. It was a rough attempt to grasp at science for mercantile purposes, and the movement has calmed down. The result is no trifle, but it is not all that was anticipated. Mechanics have shown themselves most prominent, and neither the Government nor private men have done for any branch of science what Whitworth has done for mechanicians. It is well to do one work at a time. He seldom does good who expends his efforts on the human race generally. Let us take a smaller range and try to do something in relation to the science and the scientific men that interest us most.

When Liebig was emerging from his garden tool-house there were no laboratories for students in London, and none in Oxford or Cambridge, although there were eminent chemists. Before the new Giessen laboratory was made Graham had made the Andersonian Institution in Glasgow more famous than it had ever been, and produced a school, perhaps the earliest issue of a number of trained chemists from one place at least in Britain. As the flow of thought was towards organic chemistry, and necessarily so, the new laboratory at Giessen took the lead, although the then new London colleges had both laboratories for the professors, and the Birkbeck rose to assist them.

When Liebig got his new work-rooms, he was not slow to seek the same advantage for others, and he laboured hard to induce the Prussian Government to provide accommodation for Rosé; but that Government would not listen, and England was more easily persuaded. We not only took his plan for a laboratory, but we took the teacher he sent, and if not to our own fame at least to our own advantage. Hofmann has made his most famous discoveries among us. The School of Mines had a very limited idea of its duties as regards chemistry when it gave only a corner for its exercise, and Manchester took the next most promising step amongst us by building the laboratory of Owen's College. But Germany still kept ahead, and Bunsen and Wöhler, at Heidelberg and Göttingen obtained buildings beautiful and commodious, and quite according to their own mind. Since then Oxford and Cambridge have come into the field.

Germany reviewed this advance, was dissatisfied with the constant slight increase, and there rose in her the spirit that had built her great and numerous universities, and filled her towns and even villages with public buildings. There every officer and office has such abundance of house room that we wonder much why with our wealth we should be for ever cramped.

Prussia began with two great buildings in Berlin and Bonn about three years ago, whilst Leipzic began later, but is finishing hers at the same time.

How shall we describe that of Berlin? Let us take Jermyn Street School of Mines, and multiply it by from two to three, and probably the total space occupied by the new laboratory will be found. And yet the laboratory in Jermyn Street is only a small room in a corner. The idea is destroyed that a cellar or any hole may do for a laboratory. This is a mansion of a noble kind—a palace. The idea is destroyed that the more menial the work which a student performs the greater his success. Every help is given and he is left to do that only which cannot be done by less educated persons. It is said in Germany that Hofmann has injured the student by offering him too many facilities in his work, and that when he goes to manufactories in the country he is frequently in difficulties. True, when the student leaves the university with its fine libraries and its learned professors, he is thrown on his own resources, and unless he is soundly taught and of sound mind he will not keep his position; but for a chemist to make his own apparatus was never possible, and he is every day becoming more dependent on the mechanical art. No chemist makes his own balance, although he ought to understand it, and much less should he lose time by the detested process of making sulphuretted hydrogen if he can get it done for him. If it is merely to learn let him learn; but one may as well ask him to dig his own coals out of the pit or at least bring them from the cellar. There was a time when chemistry was begun by rubbing and hammering in a heavy mortar, and this continued until the next unfortunate apprentice came; we have heard of this experience from one of the most eminent. As we rise so does the stage of menial work rise, and we begin where our forefathers ended. We may be glad as well as the student when he can turn on his sulphuretted hydrogen by a tap, and when he can even do the same with oxygen and hydrogen, and when he is saved the trouble of an air pump and can turn on a vacuum like steam. Chemists have certainly lived in unwholesome atmospheres. We are glad to see the rooms enlarged, and the passages wide and lofty, so that they may serve as places to walk in if any accident should for a while render the air impure, and we can be no less glad to see the covered spaces with open sides, which are beautifully fitted for work that cannot well be done in a fully closed room. It is interesting to see the room for spectrum analysis making a new feature in a laboratory; but one is tempted to think that even the great new buildings make this department too small, We may live to see that little room much expanded; we may learn also to look on our present mode of filtering as so slow as to be quite unendurable and the use of pressure quite indispensable. Hofmann's laboratory is a fine public ornament to a street; the buildings touch it on both sides. Kekulé's stands alone like a separate college, handsome where most things are beautiful. One wonders if those great halls and magnificent passages and stairs will ever see such discoveries as the little holes out of which the directors have got their first fame; but on second thoughts, it appears a poor remnant of an alchemistic prejudice which comdemns a chemist to a building less beautiful than those which have been given to literary men in libraries and universities, on which the skill of architects has been lavishly spent. We must remember that although these buildings appear grand to us, there are young men entering them this very quarter to whom they will soon appear as the veriest common place, and these very young men will begin on the 1st of November to stand on the shoulders of all their predecessors. They will not all fall, and when they seek for advance it will be with very lofty heads with a long vision and with a fine step rendered elastic by numerous mechanical aids.

We remember organic analyses done by charcoal furnaces in an unventilated room, which soon became so poisoned that the operator fell senseless to the ground and was only slowly restored. It is pleasant to see the preparations everywhere made for working on clean benches, where not only no dust of charcoal is found, but even the gas combustion products are carefully removed. The laboratory at Leipzic, under Kolbe, has not quite the majestic appearance of those in Berlin and Bonn; but comparisons ought not to be made of this kind, and when we look at essentials and comfort, it is by no means behind, and even accommodates more students, viz., 100 as workers. Happy must they be in working, one would think, who remembers the weary time spent over filters before the present quick filter paper was known, whilst they have Bunsen's air pressure method driving their work on with a speed which will enable these youngsters to do in a day that which we in our student times, with scarcely pervious paper, could with difficulty have done in a week.

This is written from the outer point of view only; if we seek to examine the newer mode of making lecture experiments, we should be led into long letters and contrasts, so they shall be left with this remark that the problem seems gradually solving; How shall we find time to learn so much when knowledge increases so fast? The laws of nature which long thought only could make familiar to us become simplified by being put into operation before our eyes, and the chemist learns more rapidly the complicated system of to-day than he did the few facts and principles of the previous century.

The laboratories of Berlin, Leipzic, and Bonn begin in a few days.

We are building one,—namely, in Glasgow; it is attached to the new university. We have heard little of it. It is to be hoped that it is at least twice as large as any reasonable person could wish for present use, as, if otherwise, it will soon become offensive and another will be wanted. It is to be hoped that it will be so large that every student will not be a nuisance to his neighbour whilst his own freedom is diminished,—that he will be able to work without restraint, and less incommoded than a prisoner in his cell.

We are told of another—and that a fine one—building at Kensington, and it is to be hoped that public rumour is not correct, but that it is built under the care of an eminent chemist, and that it will be in all things worthy to stand comparison with, if not to surpass, those that have risen in Prussia.

We hear also of a desire to build a new one in Manchester, but it is said that it cannot afford the money. Is it less wealthy than the town of Leipsic, which pays for the new institution there, or is it less dependent on manufactures?

We do not venture at present on a history of laboratories in England; perhaps even our slight allusions may be wanting in chronological exactness; we mean only to bring to mind the comparative slow increasing of the importance of chemistry in the eyes of public bodies. There have been long a few small laboratories in and out of London for volunteers. It would be interesting to receive communications concerning them, speaking of a time before the rise of the London University.

ON THE ANALYSIS OF A GREEN FIBROUS MINERAL FROM CATHKIN.[*]

By J. WALLACE YOUNG.

The mineral of which I now give the analysis seems to have been derived from the decomposition or alteration of hornblende. It is frequently found in the trappean districts around Glasgow, generally mixed up with more or less carbonate of lime.

Colour, blackish green; structure, fibrous; of about the hardness of talc. The powdered mineral feels greasy when rubbed between the fingers. Gives off water when heated. B.B. becomes first whitish, and then fuses on the edges to a black glass. Easily decomposed by hydrochloric acid. The following is its composition, No. 1 is the whole mineral, and No. 2 after deducting the carbonate of lime.

Dried at 100° C.

	I.	II.
Silicic Acid	31·95	33·38
Alumina	15·40	16·10
Ferrous Oxide	21·10	22·04
Magnesia	20·95	21·90
Water (by difference)	6·30	6.58
Carbonate of Lime ..	4·30	—
	100·00	100·00

NOTES ON

LEMON-JUICE AND ITS DECOMPOSITION.[†]

By W. W. STODDART, F.G.S.

Pereira gives an analysis of lemon-juice by Proust, showing that it contained 1·77 per cent of citric acid, or about 10 grains per ounce. The specific gravity is not mentioned. It is surprising that the statement should have been introduced into the last edition of that work.

In our excellent "British Pharmacopœia," freshly pressed lemon-juice is said to have an average specific gravity of 1·039, and an average quantity of 32·5 grains of citric acid per ounce. These two do not agree; the specific gravity is too great for the acid.

In Muspratt's "Dictionary," juice containing 7 per cent or 31·5 grains per ounce, is termed very superior.

In Mr. Watts's splendid work, 4·7 per cent, or 20¼ grains per ounce, is quoted as the amount.

Muspratt says that lemons at an earlier part of the season are more acid, and as the season advances the water is a percentage or two higher.

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[*] Transactions of the Geological Society, Glasgow.

[†] Read at the Norwich Meeting of the British Pharmaceutical Conference.

All these statements are so greatly at variance with the results I have found, that I am induced to bring the subject before the Conference.

The Board of Trade have fixed very liberally for the vendors the specific gravity of 1·030 as the standard, and 30 grains per ounce as the least quantity of acid.

On February 25th of this year I bought a lot of lemons from six different shops, and after mixing them I pressed eight, which gave 7 ounces of juice, having a specific gravity of from 1·040 to 1·046, and yielding 40 to 46 grains per ounce, or 9·6 per cent of citric acid.

The specific gravity was taken by one of Griffin's hydrometers, as ordered by the Board.

The remainder of the lemons were put aside till the end of May, and again examined. The result showed that as the lemons were kept, and the summer advanced, the quantity of acid decreased (at first slowly, but at length very rapidly) but the specific gravity only suffered comparatively slight diminution; the quantity of the juice also remained the same, for eight lemons yielded 7 ounces in May as in February.

On examining the remaining fruit in July the curious fact was ascertained, that although the specific gravity was 1·027, yet there was not a particle of citric acid. Analysis showed that it had all split up into glucose and carbonic acid.

Since this, the nitrogenous matter in the juice has again set the whole into fermentation. The glucose has produced alcohol, and the alcohol acetic acid, thus:—

Glucose. Alcohol.

$$C_{12}H_{24}O_{12} = 4(C_2H_6O) + 4CO_2.$$

Then, after passing through the intermediate stage of aldehyd,

Alcohol. Acetic Acid.

$$4(C_2H_6O) + 8O = 4(C_2H_4O_2) + 4H_2O.$$

On examining a vessel containing a large quantity of lemon-juice, the peculiar earthy smell of carbonic acid is distinctly perceptible. For a clearer proof, a quantity juice was put into a bottle which was connected by a glass tube with lime water, beneath which the glass tube dipped; all was hermetically sealed and laid aside, when the deposition of carbonate of calcium became sufficiently evident.

The decomposition would be explained thus:—

Citric Acid. Glucose. Carbonic Acid.

$$3(C_6H_8O_7) + 3O = C_{12}H_{24}O_{12} + 6CO_2.$$

This change is of course one example among many of the chemical transformations which take place in the maturation of fruits, and a striking one it is.

Freshly expressed lemon-juice is a thin, milky, slightly yellowish liquid, having a specific gravity from 1·040 to 1·045, and containing from 39 to 46 grains of citric acid per ounce. Should either of these be less, the lemons must have been kept too long or gathered too late in the season.

Liquor potassæ turns the juice a peculiar dark colour, well known to those accustomed to a diabetic examinations.

When freshly pressed the smell is aromatic, but when kept for a few days acquires the mouldy flavour which the commercial juice usually possesses. Trommer's and Fehling's tests give a decided indication of glucose.

With polarised light the ray is turned to the right. Acetate of lead gives a muddy white precipitate (gummate of lead).

Chloride of barium, nitrate or acetate of potassium, or chloride of calcium should give no precipitate, indicating the absence of sulphuric, tartaric, or oxalic acids. The aroma of the pure juice is very peculiar, and differs as much from any artificial compound as rose-water distilled from the petals does from that made with otto.

The juice from limes is not so acid as that from lemons.

Through the kindness of a friend I obtained a dozen limes from Glasgow; from these I obtained 5½ ounces of juice. This was very much more aromatic and more delicate in its flavour than lemon-juice. Its specific gravity was 1·037, and contained 32·22 grains per ounce. It was, therefore, not so strong as lemon-juice.

Messrs. Southall, of Birmingham, furnished a sample as coming from the Olveston plantation in Montserrat, which had a deep yellowish brown colour: this, I presume, was given artificially, as that pressed by myself from the fruit was nearly colourless.

A singular fact was communicated to me by D. Davis, Esq., Medical Inspector for Bristol, which was (at any rate to me) quite new. Of course, all chemists are aware that when citric acid is fused with potassa it is decomposed into oxalic and acetic acids, thus:—

Citric Acid. Oxalic Acid. Acetic Acid.

$$C_6H_8O_7 + H_2O = C_2H_2O_4 + C_2H_4O_2.$$

But when liquor potassæ is mixed with common lemon-juice in the cold, oxalic acid may be detected in a few days.

When lemon-juice is carefully evaporated it yields a rich brown extract, which is very peculiar both in smell, taste, and appearance, so much so that any one accustomed to make these experiments can in one moment tell whether or not it is a genuine juice.

An ounce of lemon-juice will average 27 grains of dry extract per ounce. After a certain point the extract becomes carbonised, having a rich brown colour and pleasant smell. This is owing to its partial decomposition into acetone, carbon, carbonic acid, carbonic oxide, and aconitic or pyrocitric acid.

Citric Acid. Acetone. Aconitic Acid.

$$2(C_6H_8O_7) = C_3H_6O + 2CO_2 + CO + C_6H_6O_6 + 2H_2O.$$

It seems quite impossible to evaporate the juice to dryness without decomposition.

During the first six months of the present year a great number of samples of commercial juice were examined; some were plainly artificial, a few contained sulphuric acid, but most of them were merely diluted with water. The greater number of those obtained from the retail shops were artificial, and in no single instance stronger than twenty-four grains per ounce.

The juice keeps its strength better separated from the fruit than in it. A good sample may be kept for years without sensible diminution of its acid, especially if fortified with spirit.

The cell-structure of the fruit seems to be the chief source of the fermentative matter, especially that part of the mesocarp that forms what is commonly called the white of the rind.

The ingredient in the juice, which is the therapeutic agent, seems to be a matter of dispute among medical men. Those who advocate Dr. Garrod's views—that it resides in the potash—must have a homœopathic idea of its value, and plenty of faith.

The analysis of many specimens of ash show only 3-10th grain of potash per ounce. Others, with Dr. Tanner, and I think with more reason, rely on the citric acid as the chief means for curing scurvy.

The molecules of citric acid are very remarkable for their tendency to change, especially when sugar or gum is present. As remarked before with regard to lemon-juice, so a solution of crystallised citric acid cannot be evaporated to dryness without decomposition, even with a very gentle heat.

Like all seaport towns, a great many cases of scurvy are present in Bristol, and I have the authority of several of our leading physicians for saying that they find the crystallised citric acid as efficacious as lemon-juice (especially with fresh meat and vegetables) in curing that disease.

But as this question is more in the sphere of the physician than the pharmaceutist, it had better be left in their hands for solution.

Mr. H. S. Evans knew two firms in Liverpool who imported lemon-juice direct from Messina, and the inspectors would not pass it unless it contained 7 per cent of citric acid and 5 per cent of alcohol. He had a good deal of experience in the examination of such imported juice, and had always found from 7·5 to 9 per cent of citric acid and 4 to 5 per cent of alcohol. But there was no doubt that great adulteration was practised, and the Act had done good by putting a check upon this. With regard to the case in which citric acid was said to have been used for fortifying weak lemon-juice, he (Mr. Evans) was disposed to query whether a scarcity of lemon-juice might not only justify such a procedure, but render it necessary.

The President thought that lemon-juice freshly squeezed was the only sort that should be used in pharmacy.

Mr. Deane said that he laid in a stock of lemons when plentiful in spring, squeezed the juice, heated it to 180° F., and bottled it while hot in small bottles, which were then tied over with bladder. The juice kept good for many months.

Mr. Schacht wondered what became of the citric acid which had disappeared.

Professor Attfield thought that the disappearance of citric acid, by conversion into glucose and other bodies, was one of the most important of Mr. Stoddart's observations, and should receive further attention. He hoped that members of the medical profession would institute experiments to decide whether the citric acid was the efficient agent, or the salts of potassium.

Mr. Groves said that the fruiterers recognised what they called *sweet lemons*. Had Mr. Stoddart met with some of these? He had preserved lemon-juice throughout the year by adding two minims of chloroform to a fluid ounce of juice. When the juice was required for use, warmth was applied to evaporate the chloroform.

Mr. W. L. Scott had found acid oxalate of potash in lemon-juice in two instances, the amounts being 4 and 7½ per cent respectively.

Mr. Stoddart said that the lemons which gave no citric acid had the appearance of being perfectly sound. He was aware that in Italy there were sweet lemons, of which both the peel and the juice were eaten. As to what became of the citric acid, he found that as it diminished the amount of sugar increased. He had proved that carbonic acid was formed and eliminated through the rind of the fruit by means of an air-pump and lime-water. He had never met with oxalic acid in lemon-juice.

PURIFICATION OF SEWAGE.

MR. SILLAR'S PROCESS.

By Dr. FRANKLAND, F.R.S.

The following report has been issued from the Rivers' Commission Laboratory:—

The analyses of the samples of sewage and precipitated mud taken during the recent experiments on the application of Mr. Sillar's process to the purification of the sewage of the town of Leicester, are now complete, and I herewith enclose the results in a tabulated form.

The Leicester sewage, as you are aware, has for some years past been deodorised with lime, and for the carrying out of the experiments which were shown to us, the plant was so arranged that one-half of the sewage could still be treated with lime as usual, whilst the remaining half was submitted to Mr. Sillar's new process. In this way I have been able not only to ascertain the extent to which the sewage was ameliorated by the new process, but also the comparative effect of the old lime process when applied to one-half of the same sewage.

The experiments extended over three days. On the first day a sample of the sewage as it arrived at the deodorising works was taken at 1.30 p.m., whilst at 5.40 p.m. and 6.10 p.m., samples of the effluent liquid, after treatment by the lime and Sillar processes respectively, were collected, the intervals of time being those calculated as necessary for the passage of the sewage through each of the two processes. On the second day hourly samples of the raw sewage were taken from 10 a.m. to 9 p.m., but during the morning an accident happened to a portion of the apparatus which vitiated the experimental results, and consequently the samples, after treatment, were only taken from 4 p.m. to 8 p.m., in the case of the lime process, and from 4 p.m. to 9 p.m. in that of Sillar's process. On the third day all the samples were taken hourly from 10 a.m. to 5 p.m. After our departure from Leicester on the first day the duty of taking the samples was entrusted to Mr. W. Thorp, the principal assistant in this laboratory.

Before proceeding to interpret the results of the analyses, it is necessary to premise that the strength of sewage, as regards dissolved constituents, is determined by two analytical estimations—viz., "total solid impurity," and "total combined nitrogen." A comparison of the numbers under these heads, obtained from the samples of raw sewage collected on each of the three days of the experiments, and on the occasion of our previous visit to Leicester (May 13th, 1868), shows that the sewage of this town is much below the average strength, and that it does not seem to vary in strength between very wide limits.

	May 13. lbs.	July 30. lbs.	July 31. lbs.	Aug. 1. lbs.
Total solid impurity in 100,000 lbs. of sewage	107·5	111·0	112·0	108·0
Total combined nitrogen in 100,000 lbs. of sewage..	2·524	2·102	2·229	2·014

But although the strength of the sewage separated from suspended matter was thus tolerably uniform, its quality on the last day of the experiments differed widely from that which it possessed on the previous occasions; the organic matter, in the sample collected on the third day, having become so much decomposed that a large proportion of the nitrogenous constituents had become converted into mineral compounds. This anomaly in the sewage of the 1st of August is clearly seen from the following comparison of the organic carbon and nitrogen contained in the different samples of raw sewage after filtration from suspended matters:—

	May 13. lbs.	July 30. lbs.	July 31. lbs.	Aug. 1. lbs.
Organic carbon in 100,000 lbs. of sewage	2·017	3·745	3·536	2·752
Organic nitrogen in 100,000 lbs. of sewage	0·809	0·722	0·747	0·103

The purification of sewage may be conveniently considered under two heads—1st, clarification, or the removal of suspended matters, so as to make the resulting liquid more or less clear and transparent; and 2nd, removal of matters in solution. The suspended matters contained in sewage are well known to undergo rapid putrefaction and to become very offensive; consequently their removal either by filtration or chemical treatment constitutes in itself an important amelioration in sewage. But the liquid so clarified contains in solution much nitrogenous organic matter, which is prone to become putrid, even when mixed with a considerable volume of river water.

In regard to clarification, the experiments at Leicester scarcely establish a decided superiority for Mr. Sillar's process over the method of treatment by lime. On the first day the effluent liquids were nearly equally clear; on the second day the limed sewage was markedly superior to its rival; whilst on the third day the sewage treated by the new process was much clearer than the limed liquid. These statements rest on the following comparison of the quantities of suspended matter remaining in 100,000 lbs. of the effluent sewage as well as upon ocular observations made during the three days' experiments:—

SUSPENDED MATTER.

	After Lime process. lbs.	After Sillar's process. lbs.
1st day	6·00	6·12
2nd ,, ...	2·84	4·36
3rd ,, ...	6·56	2·76

Of the soluble constituents of sewage, the most important are those given in the accompanying analytical results under the heads "Total Solid Impurity," "Organic Carbon," and "Organic Nitrogen," and the following table shows the manner in which the sewage is altered in these three respects by being submitted to the two processes. The numbers all refer as usual to 100,000 lbs. of sewage.

	TOTAL SOLID IMPURITY.		ORGANIC CARBON.	ORGANIC NITROGEN.	
	Removed. lbs.	Added. lbs.	Removed. lbs.	Removed. lbs.	Added. lbs.
LIME PROCESS.					
1st day	23·0	—	·875	·475	—
2nd ,, ...	22·0	—	·928	·407	—
3rd ,, ...	11·0	—	·519	—	·056
SILLAR'S PROCESS.					
1st day	—	6·0	·967	·425	—
2nd ,, ...	—	13·0	1·231	·374	—
3rd ,, ...	—	11·0	·713	—	·193

The numbers show that, whilst the lime process considerably reduces the amount of dissolved impurities in sewage, Sillar's process markedly augments it. The explanation is obvious: in the lime process, which is in fact an application of the late Professor Clarke's ingenious method of softening water, all the material added in solution is again precipitated in the solid form; but in Sillar's process considerable quantities of dissolved chemicals are added which are not afterwards precipitated. It is also probable that in both processes certain constituents present in the suspended matter of the raw sewage are dissolved, whilst other constituents already in solution are precipitated; there is thus finally left in solution a balance of solid matter which in the case of lime is less, but in the case of a new material greater, than the amount present in the raw sewage.

Both processes have the effect of diminishing the organic carbon, and on each of the three days the diminution effected by Sillar's process was markedly in excess of that brought about by the lime process.

The material, however, which it is of the greatest importance to remove from the dissolved constituents of sewage is nitrogenous organic matter, because it is chiefly this kind of organic matter which enters rapidly into putrefaction, and becomes an active agent in the pollution of rivers. This material is represented in the analytical results by organic nitrogen. It is precisely here that both processes signally fail (although the lime is slightly superior to the new process) in accomplishing such an amount of purification as would render the sewage admissible into an open water-course. The raw sewage on the third day was, as already mentioned, very far advanced in decomposition, and the effect of both processes upon this sewage was actually to increase the amount of organic nitrogen in solution; that is, the amount of organic nitrogen dissolved from the suspended matter of the raw sewage was greater than that precipitated by the chemical reagents added. Leaving out of consideration this result, which must be regarded as abnormal, the following table shows the amelioration effected by the two processes:—

PERCENTAGE OF ORGANIC NITROGEN REMOVED.

	Lime process.	Sillar's process.
1st day	65·79	58·86
2nd day	54·48	50·07

It may be stated, therefore, in round numbers, that, as regards putrescible organic matter, the application of either process would render it possible to double the amount of filtered sewage admitted into a river without increasing the pollution. Although this is by no means an unimportant result, yet it falls far short of what is required to restore our sewage-polluted rivers to a satisfactory degree of purity.

An inspection of the analytical table shows that the effluent sewage, after treatment by the new process, invariably contains more ammonia than the raw sewage; thus, on the first day 100,000 lbs. of sewage contained 1·650 lbs. of ammonia before treatment, and 2 lbs. after treatment; on the second day, 1·8 lbs. before and 2·5 lbs. after treatment; whilst, on the third day, it contained 2·25 lbs. before and 2·5 after treatment. The origin of this additional ammonia is not difficult to understand; in the first place, alum enters largely into the composition of the material used in the new process; and as nearly all alum now manufactured is ammonia-alum, containing 3·7 per cent of ammonia, it is probable that this is one source of the additional quantity of ammonia; but it cannot be the only source, unless we are to assume the use of such a large proportion as would render the process economically impracticable. The second, and probably the chief source of the additional ammonia is to be sought for in the action of the chemical reagents upon the nitrogenous organic matters contained in the raw sewage, partly in suspension and partly in solution. The possibility of such a liberation of ammonia is seen in the case of the limed sewage of the first day; here no ammonia was added in the reagent; nevertheless there was an increase of ·475 lbs. in each 100,000 lbs. of sewage. Such an addition to the amount of dissolved ammonia has little significance as regards the pollution of rivers, but it has an important bearing upon the applicability of the process to the economical production of a solid manure, because it indicates not only that the ammonia already in solution in the raw sewage is not precipitated, but also that some of the suspended nitrogenous matter is decomposed with the liberation of ammonia, representing so much valuable matter abstracted from the solid manure.

Notwithstanding this loss of nitrogenous organic matter in the process of deodorisation, the new method of treatment still yields a solid manure of much greater value than that obtained by the lime process—a circumstance which is explained, to a great extent, by the mud from the new process being acid, whilst the lime mud is alkaline; consequently, in drying, the latter loses ammonia, whilst the former, especially if still further acidified, cannot suffer this loss.

Both samples of mud submitted to analysis were first dried in the sun, with free exposure to the air, so as to imitate, as nearly as may be, the process of drying such manure usually employed on the large scale. By analysis, the following results, expressed in percentage numbers, were obtained:—

	Dry Mud from Sillar's process.	Dry Mud from Lime Process.
Mineral matters	54·772	37·413
Organic and other volatile matters	45·228	62·587
Carbon	24·994	18·865
Phosphoric acid	·496	·147
Total nitrogen..	1·943	·849
Ammonia	·185	·090

It is thus evident that in the three valuable constituents of manure—viz., in ammonia, in other forms of combined nitrogen, and in phosphoric acid—the manure obtained by the new process is greatly superior to that resulting from the treatment with lime. Unfortunately some doubt is thrown upon the source of the increased amount of phosphoric acid present in the manure obtained by the new process, because bone-black in, to me, unknown quantity enters into the composition of the precipitating material used by Mr. Sillar, and thus a certain amount of phosphoric acid is added to that which is actually derived from the sewage.

I estimate the value of the two manures as follows:—

	Per Ton. £	 s.	 d.
Manure from lime process	0	13	6¼
Manure from Sillar's process ..	1	13	0¾

The value of the solid manure obtained by treating the Leicester sewage with lime has already been estimated, from the analysis of Voelcker and Versmann, by Hofmann and Witt, who give the following numbers:[*]—

	Voelcker. s.	 d.		Versmann. s.	 d.
Value per ton	15	5	..	17	0

That these values exceed my estimate is partly due to the circumstance that Hofmann and Witt assigned a value of £1 a ton to non-nitrogenous organic matter, whilst I regard it as worthless. Such is the value of these deposits as estimated from chemical analysis; but experience has warned the manufacturer of these feeble manures that the value indicated by chemical analysis cannot be counted upon in the market. Thus the Leicester mud is actually sold for 1s. per ton, although its indicated value is 13s. 6¼d.

In conclusion, the results of the experiments may be thus summarised:—

1. The Sillar and lime processes remove to a great and nearly equal extent the suspended matters contained in sewage.

2. Sillar's process increases the amount of dissolved solid impurity in sewage, but reduces the quantity of putrescible organic matter. The lime process reduces both the amount of dissolved solid impurity and the quantity of putrescible organic matter; the reduction of the last being about the same as that effected by Sillar's process—viz., rather more than one-half.

3. Like all chemical methods hitherto invented, both processes fail in purifying sewage to such an extent as to render it admissible into running water. It still remains a fact, that no chemical process is known which even remotely approaches irrigation in its efficiency as a purifier of sewage.

4. For the manufacture of solid manure from sewage, Sillar's process is greatly superior to the method of treatment by lime, although it fails to extract from the liquid more than a very small fraction of its valuable constituents.

ON FOOD.[†]

By DR. LETHEBY, M.A., M.B., &c.

(Continued from page 200.)

Constructions of Dietaries: Preparation and Culinary Treatment of Foods.

The construction of dietaries for particular purposes, as for training, for developing muscular tissue, for producing fat, or for reducing it, is beyond the scope of these lectures; but it may generally be said that, as in training the object is to form muscular tissue, to give it great endurance of action, and at the same time to reduce the weight of the body, it is accomplished by the use of nitrogenous food, with but little fat or farinaceous matter, and as little fluid as possible—so that muscular tissue may take the place of fat and water; and by constant exercise, the endurance and strength of the muscular tissue is increased, and the proportion of water in the tissues is reduced. King, in training, is said to have taken for his breakfast two lean mutton chops, somewhat underdone, with dry toast or stale bread, and a single cup of tea without sugar; for dinner, 1 lb. or 1½ lb. of beef or mutton, with toast or stale bread, and very little potato or other vegetable, and half-a-pint of old ale, or a glass or two of sherry; for tea, a single cup of unsweetened tea, with an egg and some dry toast; and for supper half-a-pint of oatmeal-porridge or half-a-pint of old ale. The effect of this is to produce only a short-lived state of effectiveness; for, carried a little beyond the appointed time, it leads to disease; and even after the trial, there is often, as in the case of Heenan, terrible prostration of the system, and a necessity for returning immediately to an ordinary diet.

Foremost among the foods for developing fatty tissue are fats—as fat of meat, butter, cream, &c.; next to these are farinaceous matters—as arrowroot, starches, and the various meals; and after these are sugar, alcohol, &c.; so that in an attempt to reduce the bulk of the body, all of them, but especially the first, should be but sparingly used. Conversely, however, the use of fatty and farinaceous foods has a tendency to produce fat, and so also with fermented liquors, as beer and porter—the last having a high character for its capabilities of forming milk when drunk by nursing-women.

In associating different articles of diet, so as to secure the right proportions of the several constituents of food—fat, sugar, or starch, and nitrogenous matter, we find that we may not only rely on the sound indications of science, but may also trust, and trust safely, to the unerring guidance of our instincts—provided they have not been vitiated by fashion or perverted by evil habits. Science teaches us that the best proportions for the common wants of the animal system are about 9 of fat, 22 of flesh-forming substances, and 69 of starch and sugar; and experience also shows that these are the very proportions which we are constantly striving to maintain in our daily dietaries. Borrowing largely from the graphic illustrations of Liebig and Johnston, I may state that, whenever one kind of food is wanting in any particular constituents we invariably associate it with another that contains an excess of it. Certain meats, for example, which are deficient of fat are always eaten with substances that are rich in it—bacon is associated with veal, with liver, and with fowl, or we capon the latter, and thus increase its natural fat. We use melted butter with most kinds of fish, or we fry them in oil; while the herring, the salmon, and the eel are usually fat enough in themselves, and are dressed and eaten alone. It is with a view to similar adjustment that we mix eggs and butter with sago, tapioca, and rice; that we add oil and the yolk of an egg to salad; that we boil rice with milk, and eat cheese with maccaroni. The same instinct has determined the use of vegetables with meat, and butter with bread. Bacon and greens, or beans and bacon, like pork and peas-pudding, is a conjunction of viands which does not owe its popularity to old habit or the mere taste of the epicure; and so with a dish, common in Ireland, under the name of Kol-cannon: the potato, which is poor in gluten, and the cabbage, which is usually rich in this ingredient, are mixed together, and thus they approach the composition of wheaten bread, but both of these substances are deficient in fat; add, therefore, a little bacon or fat pork to the mixture, and you have a Kol-cannon which has all the good qualities of the best Scotch oatmeal, and to many it is more savoury and palatable. Again, the mixture so usual in Ireland and Alsace, of butter-milk or curdled milk and potatoes, and the combinations of rice and fat which make the diet of eastern nations; even the little dab of butter upon the poor man's potato, and the bit of cheese that he eats with his dinner, are matters not of luxury but of necessity, and they show how by long experience we have at last learnt to adjust the proximate constituents of food, so as best to maintain the health and vigour of the body.

And then, again, the times for taking food, and the proper distribution of it in appropriate meals, are questions of considerable importance, notwithstanding that they have ever been influenced by the caprices of fashion and the artificial habits of society. How much they have had to do with the modification of the human species, and even with the extinction of whole races of men, is an etiological problem of much interest.

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[*] Report on the Main Drainage of the Metropolis, by Hofmann and Witt, 1857, page 19.

[†] The Cantor Lectures, delivered before the Society of Arts.

Man, in his savage condition, feeds with great irregularity, for when he finds that food is plentiful he eats from morning till night, and knows no other pleasure than eating and drinking and sleeping; but when it is more scarce he is content with a single meal a day. In both cases, however, the quantity of food consumed is excessive. We are told by travellers that the Hottentots, the Bushmen, and the inhabitants of South Africa, who feed in this manner are enormous gluttons. "Ten of them," says Barrow, "ate, in his presence, an ox, all but the hind legs, in three days; and the three Bosjesmen that accompanied his waggon, devoured a sheep on one occasion in less than twenty-four hours." Parry, Ross, and others, have also given the most astonishing accounts of the dietetical capabilities of the Esquimaux. Captain Parry once tried the capacity of a young lad scarcely full grown, and in 24 hours he had eaten 4 lbs. 4 ozs. of the raw hard-frozen flesh of a sea-horse, the same quantity of it boiled, 1 lb. 12 ozs. of bread and bread-dust, besides a pint and a quarter of rich gravy-soup, a tumbler of strong grog, three wine-glasses of raw spirits, and nine pints of water. According to Sir John Ross, the daily rations of an Esquimaux are 20 lbs. of flesh and blubber. But the most marvellous example of gluttony is given by Captain Cochrane, on the authority of the Russian Admiral Saritcheff, who was told that one of the Yakuti had consumed the hind quarter of a large ox in twenty-four hours, together with 20 lbs. of fat, and a proportionable quantity of melted butter. To test the truth of this, he gave him a thick porridge of rice boiled down with 3 lbs. of melted butter, weighing together 28 lbs.; although the glutton had already breakfasted, yet he sat down to the meal with great eagerness, and consumed the whole without stirring from the spot; and, except that his stomach betrayed more than ordinary fulness, he showed no sign of inconvenience. Captain Cochrane further adds that a good calf, weighing 200 lbs., will just serve for a meal for four or five Yakuti; and that he has himself seen three of them consume a reindeer at a meal. Liebig acccounts for this by saying that a nation of hunters, especially when they go naked and are exposed to great losses of temperature, must consume large quantities of respiratory food; and if it so happens that the food is in its least effective form, as lean flesh, the quantity disposed of is enormous.

Among civilised nations, and until comparatively recent times, there were but two meals a day—viz., dinner and supper. These were the meals of the Romans—the prandium or dinner being for the most part a light refreshment, eaten while standing, at about nine o'clock in the morning; and it generally consisted of the cold remains of yesterday's supper. It was commmonly taken without wine; and, in fact, there was so little ceremony about it, that Plautus, in his comedies, has facetiously called it *caninum prandium*. The great meal of the day was the supper, or *cœna*, which was taken about three or four o'clock in the afternoon, and to which friends were invited. This was the ceremonious meal for which the wealthy and high families of Rome exhausted the resources of luxury and art. It always consisted of three parts—the *gustus* or antipast, which was intended as a mere smack or relish to whet the appetite. Then came the main part of the feast—consisting of many courses, with a chief dish, or *caput cœnæ*, and when in thrifty families it was the only dish which went the round of the frugal board, it was aptly termed the *cœna ambulans*. After this there came the second course, or *mensa secunda*, composed of fruits and pastry, like a modern dessert.

The sums of money expended by the wealthy Romans on this meal were often ruinous. Vitellius is said to have spent as much as 400 *sestertia* (about £3,228 of our money) on his daily supper; and the celebrated feast to which he invited his brother Lucius cost no less than 5,000 *sestertia*, or £40,350 sterling. It consisted, according to Suetonius, of 2,000 different dishes of fish and 7,000 of fowls, with other equally numerous meats. His daily food, says our classical writer, was of the most rare and exquisite nature, the deserts of Libya, the shores of Spain, the waters of the Carpathian Sea, and even the coasts and forests of Britain, were diligently searched for dainties to supply his table; and had he reigned long he would, says Josephus, have exhausted the great opulence of the Roman Empire. Ælius Verus, another of those worthies, was hardly less profuse in the extravagance of his suppers; for it is said that a single entertainment, to which only about a dozen guests were invited, cost above 6,000,000 sesterces (6,000 *sestertia*, or nearly £48,500); and we are told by historians that his whole life was wasted in eating and drinking—being spent in the voluptuous retreats of Daphne, or else at the luxurious banquets of Antioch. So profuse, indeed, was the extravagance of those times, that to entertain an emperor at a feast was to encounter almost certain financial ruin—one dish alone at the table of Heliogabalus has been known to cost about £4,000 of our money; no wonder, therefore, that these imperial feasts were lengthened out for hours together, and that every artifice, often revolting in the extreme, was used to prolong the pleasure of eating, or that Philoxenus should have wished that he had the throat of a crane with a delicate palate all the way down.

Hardly less extravagant were the dining propensities of our own forefathers, who in every way copied too closely the luxurious habits of their Roman conquerors. In fact no circumstance, as Mr. Wright observes, is more remarkable in ancient history than the readiness with which the people who came under the sway and influence of Rome, abandoned their nationality, and followed the luxurious habits of their rulers. Even so late as the time of Holinshed, the famous chronicler of the sixteeenth century, the manners of the English were the subject of severe comment; for he tells us that "in number of dishes and changes of meat, the nobility of England (whose cooks are for the most part musical-headed Frenchmen and foreigners) do most exceed; sith there is no day in manner that passeth over their heads, wherein they have not only beef, mutton, veal, lamb, kid, pork, cony, capon, pig, or so many of them as the season yieldeth, but also some portion of the red and fallow deer, beside great variety of fish and wild fowl, and thereto sundry other delicates, wherein the sweet hand of the seafaring Portingale is not wanting; so that for a man to dine with one of them, and to taste of every dish that standeth before him, is rather to yield unto a conspiracy with a great deal of meat for the speedy suppression of natural health, than the use of a necessary meal to satisfy himself with a competent repast to sustain his body withal." He adds, too, "that gentlemen and merchants keep much about the same rate; and when they make their ordinary or voluntary feasts, it is a world to see what great provision is made of all manner of delicate meats from every quarter of the country, wherein, beside that, they are often comparable herein to the nobility of the land; so that they will seldom regard anything that the butcher usually killeth, but reject the same as not worthy to come in place. In such cases, also, geliffes of all colours, mixed with a variety in the representation of sundry flowers, herbs, trees, forms of beasts, fish, fowls, and fruits; and thereunto march-pane, wrought with no small curiosity, tarts of divers hues and sundry denominations; conserves of old fruits, foreign and home-bred; suckets, codiniacs, marmalades, sugarbread, gingerbread, florentines, wild-fowl, venison of all sorts, and sundry outlandish confections, altogether seasoned with sugar, besides infinite devices, not possible for me to remember."

The learned Caius, also, in his "Counseill against the Sweat" of the same century (1552) comments in severe terms on the gluttony of his time, saying that the reason why the disease attacks the English more than others is, that they have "so moche sweating stuffe, so many euille humoures laid up in store, fro this displeasante, feareful, and pestilent disease, cause of their euille diet, whiche destroy more meates and drynckes withoute al ordre, conveniet time, reason, or necessite, the either Scotlande, or al other countries under the sunne."

Gradually, too, as the dinner got to be later in the day, and reached noontime, there was necessity for a light early meal, or breakfaste, as it was called; and as the dinner became later and later still, a fourth meal was added—the lunch or luncheon, which literally meant a slice of bread. In process of time, also, with the introduction of tea and coffee into England, there came a fifth meal; but all along the dinner was the great feast of the day; and the rule in using it was pretty much as Dr. Kitchener, in his time, advised—viz., to eat until there was a sense of satiety, the stimulus of every fresh dish being but as a whip to the appetite, so that the sense of satiety might come and go a dozen times. "It is produced in us," says Christopher North, "by three platefuls of hotch-potch, and to the eyes of an ordinary observer our dinner would seem to be at an end; but no—strictly speaking, it is just going to begin. About an hour ago did we, standing on the very beautiful bridge of Perth, see that identical salmon, with his back fin just visible above the translucent tide, arrowing up the Tay, bold as a bridegroom, and nothing doubting that he should spend his honeymoon among the gravel-beds of Kinnaird or Moulenearn, or the rocky sofas of the Tummel, or the green marble couches of the Tilt. What has now become of the sense of satiety? John—the castors!—mustard—vinegar—cayenne—catsup—peas and potatoes, with a very little butter—the biscuit called "rusk"—and the memory of the hotch-potch is as that of Babylon the great." Sense of satiety, indeed!—"We have seen it for a moment existing on the disappearance of the hotch-potch—dying on the appearance of the Tay salmon—once more noticeable as the last plate of the noble fish melted away—extinguished suddenly by the vision of the venison—again felt for an instant, and but for an instant, for a brace and a half of as fine grouse as ever expanded their voluptuous bosoms to be devoured by hungry love."

We smile at the accounts given of the gormandising powers of the natives of Arctic regions and the savages of Southern Africa, but our own habits in eating and drinking are scarcely less preposterous. Look at a modern dinner; beginning with soup, and perhaps a glass of cold punch; to be followed by a piece of turbot or a slice of salmon with lobster-sauce; and while the *caput cœnæ*, the venison or South down, is getting ready, we toy with an oyster paté or a bit of sweat-bread, and mellow it with a bumper of Madeira. No sooner is the venison or mutton disposed of, with its never-failing accompaniments of jelly and vegetables, than we set the whole of it in a ferment with champagne, and drown it with hock or sauterne. These are quickly followed by the wing and breast of a partridge, or a bit of pheasant or wild duck; and when the stomach is all on fire with excitement, we cool it for an instant with a piece of iced pudding, and then immediately lash it into a fever with undiluted alcohol, in the form of cognac or a strong liqueur; after which there comes a spoonful or so of jelly as an emollient, a morsel of ripe stilton or paté de foie-gras as a digestant, a piquante salad to whet the appetite for wine, and a glass of old port to persuade the stomach, if it can, into quietness. All these are more leisurely succeeded by the *mensa secunda*, or dessert, with its ices, its preserves, its bake-meats, its fruits, its geliffes, codiniacs, and suckets, as Holinshed would call them, and its strong drinks; to be afterwards muddled with coffee, and complicated into a rare mixture with tea, floating with the richest of cream.

As a modest example of this sort of thing, and an indication moreover of the kind of novelties yet in store for us, let me read to you the *menu* of a late dinner at the Langham, where horse-flesh was the principal *viande*. It is very appropriately prefaced with a little bit of French philosophy—"*Les préjugés sont des maladies de l'esprit humain.*"

"*Potages*—Consommé de cheval. A la purée de destrier. *Amontillado.*

"*Poissons*—Saumon à la sauce Arabe. Filets de soles à l'huile hippophagique. *Vin du Rhin.*

"*Hors-d' œuvres*—Terrines de foie maigre chevalines. Saucissons de cheval aux pistaches syriaques. *Xérès.*

"*Relevès*—Filet de Pégase rôti aux pommes de terre à la crême, Dinde aux châtaignes. Aloyau de cheval farci à la centaure aux choux de Bruxelles. Culotte de cheval braisée aux chevaux-de-frise. *Champagne sec.*

"*Entrées*—Petits pâtés a la moëlle Bucéphale. Kromeskys à la Gladiateur. Poulets garnis à l'hippogriffe. Langues de cheval à la Troyenne. *Chateau Perayne.*

"SECOND SERVICE.

"*Rots*—Canards sauvages. Pluviers. *Volney.* Mayonnaises de homard a l'huile Rosinante. Petits pois à la Française. Choux-fleurs au parmesan.

"*Entrements*—Gelée de pieds de cheval au marasquin. Zephirs sauté à l'huils chevaleresque. Gateau vetérinaire a la Ducroix. Feuillantines aux pommes des Hesperides. *St. Peray.*

"*Glaces*—Crême aux truffes. Sorbets contre-préjugés. *Liqueurs.*

"*Dessert*—Vins de fins Bordeaux. Madère. Café.

"*Buffet*—Collared horse-head. Baron of horse. Boiled withers."

Even put into plain English all this would sound remarkable, and taken, as it is said to have been, without shying or gibbing, although, perhaps with a little bolting, it must have puzzled the stomach; and, like all our modern dinners, must also have severely taxed its powers in selecting from the complicated mess, the right proportions of fat and flesh, and farinaceous matter required for the sustenance of the body.

Nor is it right to content ourselves, like savages, with a single meal a day, as was the custom of Dr. Fordyce, the celebrated professor of chemistry of the last century. Studying the habits of carnivorous animals, and reflecting on the principles of chemistry and physiology, he came to the conclusion that man required but one meal a day for all his physiological wants, and for more than twenty years his daily dinner was as follows:—Regularly at four o'clock of an afternoon he would present himself at "Dolly's Chop House," and take his seat at the table reserved for him. Immediately on his arrival the cook would place a pound and a half of rump-steak upon the gridiron, and while it was cooking the doctor would amuse himself with some such trifle as half a broiled capon, or a plate of fish, and a glass or two of brandy—his regular allowance being a quarter of a pint. Then came the steak with a full accompaniment of bread and potato, and it was always served with a quart tankard of strong ale. This was followed by a bottle of old port; and, when the dinner was finished, as it invariably was in an hour and a half, he walked leisurely to his rooms in Essex Street in the Strand, where he met his class and gave his lecture on chemistry.

But these are not habits of the great bulk of mankind, and although they may have been practised for a while with impunity, yet they serve not as illustrations of what ought to be done in the way of eating, but rather as examples of the wonderfully accommodating power of the stomach under the most disadvantageous circumstances; for experience teaches us that three meals a day, of the simplest quality, are best suited for our wants—breakfast to supply the want of long fasting, and to restore the waste of secretion during the night; dinner in the middle of the day to support the system during the fatigue of ordinary labour; and a light meal at night, in the form of tea or an early supper, to carry on the functions of repair and secretion during the night. According to Dr. Edward Smith, the daily distribution of the food, supposing a physiological diet of 4,300 grains of carbon, with 200 grains of nitrogen to be taken, should be somewhat in this manner:—

	Carbon. grs.	Nitrogen. grs.
For Breakfast	1,500	70
For Dinner	1,800	90
For Supper	1,000	40
Total in the day ..	4,310	200

So that about one part should be eaten for supper, one and a half for breakfast, and about two parts for dinner.

It is hardly necessary to say, that in constructing dietaries, the foods should be associated in such a way as not to offend the appetite or burden the digestive powers; and that they should also be varied from time to time, not merely in their kind, but also in their treatment, as in the manner of cooking and flavouring them; for the best descriptions of food will, if eaten in the same fashion day after day, occasion disgust, and be wasted. This is often the case in the badly-arranged dietaries of workhouses, and on ship-board. It was once so with the dietaries of the English army, when the same daily rations of boiled meat were provokingly served out to the men, while they listened to the tune of "Oh the roast-beef of old England." All this is easily provided for, and it is true economy to do so, by varying the food, the mode of cooking it, the manner of flavouring it, and by serving it, in the case of dinner, with different kinds of vegetables. In constructing dietaries, therefore, the main considerations are the due supply of the right proportions of nitrogenous and carbonaceous matters; for when these are not adjusted in a proper manner, the health is endangered, and the constitution may be slowly underminded. To use the words of Liebig—"there is a law of nature which regulates these things, and it is the elevated mission of science to bring this law home to our minds; it is her duty to show why man and animals require such admixture in the constituents of their food for the support of the vital functions, and what the influences are which determine, in accordance with the natural law, changes in the admixture.

"The knowledge of the law elevates man in regard to an important function which he possesses in common with the lower animals, above the level of those beings which are destitute of reason, and supplies him, in the regulation of those bodily wants which are essential to his existence and prosperity, with a protection which the lower animals do not require, because in them the commands of the instinctive law are not opposed or overpowered by the allurements of sense, or by a perverted and resisting will."

The recognition of this law, and the practical application of it to the dietaries of a community, are obviously of great advantage, for not only would they tend to increase the health and strength of the population, but they would also effect a great economy in the general use of food. That there are difficulties in the way of such an application cannot be doubted; in fact, the natural peculiarities of individuals, to say nothing of the differences of occupation, and the ever-varying quality of the food itself, are enough to create a doubt as to the possibility of its general application until the progress of science has gone far beyond its present position. Nevertheless, there are certain well-acknowledged facts at our disposal which may safely serve as a guide to practice.

The diseases which are incidental to an abuse of the law can hardly be discussed in this place, but it may be said, in general terms, that too much or too little of either of the main constituents of food will soon be followed by marked derangements of the animal body. An excess of respiratory food not only promotes the growth of fat, but actually interferes with the nourishment of muscular tissue. Those who feed largely on rice, on potatoes, or other farinaceous foods, or who indulge too freely in malt liquors, have commonly a bloated appearance, and have no faculty for sustained exertion. The brewer's drayman, for example, is a bad subject for the ward of a hospital; and although he sometimes looks strong and muscular, yet in reality his vital power is feeble, and his tissues are fatty rather than muscular. The same is often the case with animals in the Zoological Gardens, when too large a quantity of respiratory food has been eaten, and their flesh has undergone a kind of fatty degeneration.

On the other hand, when the plastic elements of the food are in excess, the system becomes excited, too much blood is formed, and diseases of a plethoric character are induced. According to Liebig and his followers, an excess of force is developed, which manifests itself in irritability of temper, and in a savage disposition. How far this may be concerned in the frequently ungovernable conduct of our over-fed convicts may be deserving of consideration. A nation of animal feeders, says Liebig, is always a nation of hunters, for the use of a rich nitrogenous diet demands an expenditure of power, and a large amount of physical exertion, and this is seen in the restless disposition of all the carnivora of our menageries.

A deficiency of food, however, is quickly followed by a general breaking up of the animal frame. Plague, pestilence, and famine are always associated in the public mind; and the records of every country show how closely they are related. The medical history of Ireland is remarkable for illustrations of how much mischief may be occasioned by a general deficiency of food. Always the habitat of fever, it every now and then becomes the very hotbed of its development. Let there be but a small failure in the usual imperfect supply of food, and the lurking seeds of pestilence burst into frightful activity. The famine of the present century is but a too forcible illustration of this, for it produced epidemics which had not been witnessed in this generation, and it gave rise to scenes of devastation and misery which are not surpassed by the most appalling of the middle age. The principal form of the scourge was known as the contagious famine fever, and it spread, not merely from end to end of the country in which it had originated, but, breaking through all boundaries, it crossed the broad ocean, and made itself painfully manifest in localities where it was previously unknown. Thousands fell under the virulence of its action, for wheresoever it came it struck down a seventh of the people, and of those whom it attacked one out of nine perished. Even those who escaped the fatal influence of it were left the miserable victims of scurvy and low fever. Another example, not less striking, of the terrible consequences of what may be truly called famine, was the condition of our troops during the early part of their sojourn in the Crimea. With only just enough of food to maintain the integrity of the system at a time of repose, and at ordinary temperatures, they were called upon to make large muscular exertions, and to sustain the warmth of the system in the midst of severe cold. What could be expected but that the scourges which wait upon famine, as fever, diarrhœa, dysentery, and scurvy, should make their appearance in great force, and that the soldiers should perish by thousands. With an average strength of 24,000 men, the deaths from sickness alone, in the course of seven months, were at the rate of thirty-nine per cent, and in some cases it amounted to seventy-three. "Never before," says Colonel Tulloch, "is there record of a British army having sustained so frightful a loss in so short a time." During the Peninsula war, though the troops occasionally suffered much from sickness, the loss from that cause did not average above 12 per cent for a whole year. Even in the ill-fated expedition to Walcheren, which threw the nation into mourning, the deaths amounted to only about 10½ per cent for the half year; and here, in this great city, with all the aggravating circumstances of want, vice, infancy, old age, and disease, it did not reach 2 per cent during the time that our strong men were dying by thousands. "Armies have perished by the sword, and have been overwhelmed by the elements, but never, perhaps," says Colonel Tulloch, "since the hand of the Lord smote the host of the Assyrians, and they perished in a night, has such a loss from disease been recorded as on this occasion."

May the lesson of so great a calamity be wisely applied in the future.

The connection of scurvy with improper or insufficient food is a matter of medical history, and its prevention by the use of fresh vegetables, especially potatoes, is so well known that it has often been the subject of legislation. Rarely appearing in the cabin, where the dietary is good, it is a frequent visitor to the forecastle; so that half the men of our sea-going vessels are found to be suffering from the disease when they return to port. As many, indeed, as 70 per cent of a ship's crew are not unfrequently disabled by it; and there is no saying how many of the disasters at sea are caused by the inability of the men to work the vessel in times of severe weather. The legal supplementary allowance in emigrant vessels of 8 ozs. of preserved potato, 3 ozs. of other preserved vegetables (carrots, turnips, onions, celery, and mint), besides pickles, and 3 ozs. of lemon-juice for each person weekly, is found to be a perfect prophylactic of the disease, so that the one essential cause of it is evidently a privation of vegetable food.

And not less important are the morbific results of too much or too little saline matter in the food. I have already spoken of the salutary effect of certain calcareous salts in the water we drink; but according to Dr. Grange, the presence of magnesian salts in the water of a district may have something to do with the development of those remarkable forms of disease which are known as goitre and cretinism. In France, Germany, England, Sardinia, among all classes of people, of all habits, and in every variety of climate, those diseases are endemic where the soil is composed of magnesian rock, and the water charged with magnesian salts. How far the connection extends is a chemico-physiological problem that has yet to be determined.

(To be continued).

FOREIGN SCIENCE.

Paris, Nov. 4, 1868.

Laws of Double Decomposition.—Manganoso-manganic Fluoride.—Eruptive Rocks.—Ozone Free from Nitrous Compounds. Academy of Sciences: New Combinations of Orcine.—Researches on the Combustion of Oil.—Analysis of a Meteorite.

Berthollet wishing to give an explanation of the law bearing his name, stated that when two salts formed of different acids and bases encounter each other in the same solution, the liquid will contain also in a certain proportion the two other salts resulting from the double decomposition of the first. In the case of an acid and a salt, or a base and a salt, he stated in effect, that after solution, the liquid should contain, besides the two bodies dissolved, the acid or the base of the salt in the free state, as well as the salt resulting from double decomposition. M. Méhay has experimented upon this subject with the aid of an endosmometer. The vessel was circular, and the active surface a sheet of parchment paper, which remained the same for all the trials; these experiments were all made at sensibly the same temperature + 10° C.

In a first experiment, there were placed in the endosmometer a half litre of liquid, containing 200 alkalimetric degrees of sulphuric acid, or 10 grammes of monohydrated acid, and an equivalent quantity of chloride of magnesium, which we may also represent by 200 degrees in equivalent sulphuric acid. The endosmometer was placed in a reservoir containing 1 litre of distilled water, and the experiment left to itself for an hour. At the end of this time the water of exosmose was collected and submitted to ordinary analytical processes. The following results, which are still expressed in equivalent degrees, were obtained:—Free acid, = 25·00; sulphuric acid, = 7·50; chlorine, = 19·15; magnesia, = 2·60. Evidently, from these figures, the water of exosmose contained in the free state a portion of both the acids; in fact, the quantity of chlorine found being 19·15 degrees, and that of magnesia 2·60 only, this liquid contains at the least (19·15 − 2·60 =) 16·55 of free hydrochloric acid. Likewise, with the sulphuric acid, a minimum of (7·50 − 2·65 =) 4·85 degrees.

The existence of these acids in the free state in the water of exosmose being thus proved, one may conclude that these two bodies existed also in the free state in the solution experimented upon. But the sulphuric acid and the magnesia being there in equal equivalents, it is evident that if a part of this acid is in the free state, an equivalent quantity of magnesium should be in the state of chloride. From the presence of free hydrochloric acid in the solution that of an equivalent quantity of sulphate of magnesia may be inferred. The exactitude of Berthollet's hypothesis is thus demonstrated for this case. The experiment described above was repeated, employing in the same conditions 200 degrees of hydrochloric acid and 200 degrees of sulphate of magnesia; in the water of exosmose the quantities of the components were sensibly the same as those obtained in the converse experiment, viz., free acids, = 24·15; sulphuric acid, 7·40; chlorine, 19·20; magnesia, 2·45. Hence the state of the salts in solution may be considered the same in both cases. If in the trial previously made, the amount of sulphate of magnesia remaining constant, the proportion of hydrochloric acid be augmented, according to Berthollet, the quantity of chloride of magnesium, and consequently the quantity of free sulphuric acid should augment in the same sense. Hydrochloric acid exerting only a feeble influence on the diffusive power of sulphuric acid, the amount of sulphuric acid in the water of exosmose should increase progressively. This result has been obtained by experiment. However, when the two acids differ little in energy, a somewhat different case presents itself. In repeating the experiments with the endosmometer upon a mixture of sulphate of soda and boracic acid, the amounts of sodium and sulphuric acid in the water of exosmose were found to be in equivalent proportion. A similar result was obtained with acetic acid and sulphate of soda, or sulphate of magnesia. M. Méhay says, that in this case it is necessary to admit that chemical action does not take place, or at least that the quantities of borate or acetate formed are inappreciable.

At one of the recent meetings of the Academy, M. Nicklès presented a memoir on "Manganoso-manganic Fluoride." When pure peroxide of manganese is treated with hydrofluoric acid, as in making fluomanganous acid, the solution sometimes becomes covered by an abundant brown crystallisation; this is more frequently produced when operating with a warm solution. M. Nicklès separated some of these crystals, which upon analysis gave numbers corresponding with the formula,

$$MnFl + Mn_2Fl_3 + 10HO.$$

Manganoso-manganic fluoride is soluble in water, which becomes coloured brown; it is decomposed by much water like fluomanganites, giving rise to a brown deposit of oxide; with the alkaline carbonates it produces effervescence, oxide of manganese being deposited. With fluoride of potassium, a rose coloured precipitate is formed. Like fluomanganous acid, it corrodes silver; agitated with silver foil or powder, the solution gradually dissolves this metal, at the same time passing into the state of protofluoride and becoming colourless. Nevertheless, the solution always contains a little manganese, and fluoride of potassium causes a precipitate which contains fluorine, manganese, silver, and potassium in very variable proportions. In general, manganoso-manganic fluoride reacts like sesquifluoride and perfluoride of manganese. M. Nicklès has previously stated that while $MnFl_2$ resembles $MnCl_2$ by its composition, it differs in properties, being more stable than the chloride, and playing freely the part of an acid. After this, to find it uniting to MnFl, forming a fluosalt capable of ranking with

$$Mn_3O_4 = MnO + Mn_2O_3,$$

is not astonishing. Here is then, says M. Nicklès, a fresh fact to apply to the tendency already recognised by him in the singular compounds of chlorides, of compounds being proportionately acid to the lowness of the equivalent, and of their gaining stability in the same proportion. Analogous results have been obtained with iron; M. Nicklès promises to communicate them to the Academy shortly.

The only paper of chemical interest communicated to the Academy on September 14th was "A Note on a Process for obtaining Pure Hydrogen without Odour by the Action of Chloride of Ammonium on Zinc," from M. Delaurier. At the meeting on the 21st, M. Tenzsch informed the Academy that he had discovered microscopic aquatic plants in certain rocks termed eruptive; MM. L'Hote and St. Edme addressed a note on "The Generation of Ozone in Oxygen and in Air influenced by the Electric Spark of Condensation," and M. Commaille a note "On Phosphoretted Hydrogen, and on the error it may occasion in the Determination of Oxygen."

MM. L'Hote and St. Edme, in connection with the application of ozonised air in ventilating large buildings, have examined the character of the ozone obtained in passing air through Ladd's condensing apparatus. They find the air leaving the apparatus to be free from nitrous compounds.

On the 28th, M. de Luynes communicated a memoir "On some New Combinations of Orcine," and MM. Scheurer-Kestner and C. Meunier "An Account of their Further Researches on the Combustion of Oil;" M. Pisani communicated "The Analysis of a Meteorite which fell at Oran s on the 11th July, 1868."

Orcine combines directly with picric acid to form a definite compound, which is prepared in the following manner:—Picric acid is placed in a porcelain dish with a quantity of water insufficient to dissolve it, and the mixture heated to ebullition. The undissolved picric acid forms an oily layer at the bottom of the dish. On adding orcine gradually, each fragment is observed to dissolve, forming a red tint, at the same time that the proportion of undissolved picric acid diminished. At a certain moment the quantity of orcine added is sufficiently great for the whole of the picric acid to be dissolved. For 20 grammes of picric and 100 grammes of water, 12 or 14 grammes of crystallised orcine are required. On cooling, crystals resembling in colour bichromate of potash make their appearance. The crystals are drained quickly and placed in vacuo; they become yellow in drying. The compound thus obtained is very deliquescent; it is soluble in alcohol and in ether. Benzol destroys the combination. Heated on platinum, it fuses and burns with a bright flame. Analysis gave results corresponding with the formula—

$$C_{12}H_3(NO_4)_3O_2,C_{14}H_8O_4 = C_{26}H_{11}N_3O_{18}.$$

The compound thus contains equal equivalents of orcine and picric acid, and may be ranged with the products that picric acid forms with carbolic acid and certain hydrocarbons. The aqueous solution dyes silk in the same way as a solution of picric acid; orcine might possibly serve to facilitate the solution of picric acid.

Pyrogallic acid in presence of picric acid and water behaves similarly to orcine; it forms a compound crystallised in large plates, blackening slightly in the air, and containing picric acid and pyrogallic acid.

Orcine combines with nicotine. When aqueous solutions of orcine and nicotine are mixed, an oily matter is precipitated, which collects into slightly pink drops. This compound is dissolved in an excess of nicotine. Pyrogallic acid gives, under the same circumstances, an oily product gradually browning in the air. M. Wurtz has shown that in certain cases oxide of ethylene comports itself towards certain salts as a base; thus it displaces magnesia from chloride of magnesium. Oxide of ethylene appears to combine with orcine, like organic bases. On introducing a piece of solid orcine, previously fused, under a bell jar full of gaseous oxide of ethylene, the orcine gradually liquefies, at the same time the gas is abundantly absorbed; 1 gramme of orcine absorbs more than 400 c.c. of oxide of ethylene at ordinary temperature and pressure. By contact with solid potash the gas is set at liberty. The aqueous solution of orcine dissolves rosaniline, becoming of the intense colour of an alcoholic or acid solution. Finally orcine seems to combine with chloride of sodium.

M. Pisani in his analysis of the meteorite which fell on July 11th, 1868, at Ornans (Doubs), after the complete analysis gives the following numbers for the proximate constituents:—peridote, 75·10, unattackable silicate, 15·26, nickeliferous iron, 1·85, magnetic pyrites (Fe_7S_8), 6·81, and chromiferous iron, 0·4. He remarks that the proportion of peridote in this meteorite is much larger than in any other known.

CORRESPONDENCE.

ARTIFICIAL MANURE.

To the Editor of the Chemical News.

Sir,—Although I perfectly agree with Mr. Little as to the necessity of doing something to put a stop to the large number of "quack" fertilisers now deluging the market, I must take exception to the way in which he seeks to carry his point. My counsel to him would be the same as Dr. Abernethy's (when sounded by a friend for a gratis opinion)—"Go, sir, and take advice." It appears to me, that to combine as a sort of co-operative society—1st, to obtain a given manure at a cheap rate; and 2nd, to get an opinion, or rather series of opinions, from our eminent men, by inaugurating a controversy on manures, into which many of our chemists will plunge eagerly—is not the most likely course to be of any ultimate service, although it may be a cheap one in the meantime. If the farmers of a county, or division of a county, would combine, and pay a retainer to a properly educated chemist, who would in return agree to reside amongst them, and give his services at some nominal fixed scale of fees, what an incalculable advantage it would be to them. A farmer would then be free to purchase any suitable manure for his crops in the cheapest market, and, by simply sending his samples to the Society's Laboratory, he would at once be advised what to use and what to shun. This would soon drive the "quacks" from the field, while the ordinary competition amoug manufacturers, would keep the prices down by the usual rule of free trade.

I hold, therefore, that the true *panacea* is the appointment of a qualified chemist by every Chamber of Agriculture throughout Britain, and that thereafter no farmer should buy any artificial manure, except under his advice, deduced from actual analysis of the sample handed in by the trader, and confirmed by another analysis of a fair sample of the bulk delivered. In such a laboratory provision might also be made for the instruction of sons of members in the elements of agricultural chemistry while to that branch of science itself, an impetus would be given by increasing the number of paying appointments, and so inducing many clever young men to study chemistry, who are at present kept out of our profession by their poverty, and by the almost utter hopelessness of living by it in after life. I trust, therefore, in conclusion, that the chemists of England will not, in justice to themselves, be induced to enter upon the discussion sought to be inaugurated until it is started, not by the farmers, but by the chemists themselves who have been appointed as above proposed.

I should have liked to have said something on their "superphosphate" ideas, but, as that would be to enter upon the very discussion I deprecate, I must reserve my remarks for a better occasion.—I am, &c.,

John Muter.

New Kennington Institute,
November 2, 1868.

MISCELLANEOUS.

Liebig's Extract of Meat.—A paragraph having appeared in *Once a Week*, containing imputations upon Liebig's extract of meat as an article of food, the following explanatory letter, addressed to the editor of *Once a Week*, has been forwarded to us for insertion:—

"Sir,—Your last number, dated 31st October, refers to assertions of a Dr. Kemmerich that Liebig's extract of meat acts, in large doses, as a poison. You are probably not aware that extract of meat is, in fact, nothing but solid beef tea, from which the water has been evaporated, free of fat and gelatine; and that the extract has been used both for medical and household purposes for years past, with such increasing success that the main difficulty of dealers generally has been to find an adequate supply for the rapidly augmenting demand. The medical profession, eminent scientific authorities, and Government Commissions have reported very favourably on extract of meat as an article of food, and there has never been a single instance of its use having produced any injurious effect. It is manifest that the insinuation that the extract is poisonous in any way is perfectly absurd.—I am, Sir, your obedient servant, Chas. Rotter, Secretary."

Failure of Photographing the Eclipse in India.—It is a matter for deep regret and mortification that the photographic part of the operations of the expedition sent out from England to India to observe the late solar eclipse was a comparative failure. Some weeks ago the members of the Royal Astronomical Society received copies of a letter sent by Major Tennant to the Astronomer-Royal, recording the results obtained at Guntoor on the 18th of August. The photographic portion of the report was so unsatisfactory, or even humiliating, that we felt little inclination to publish it. An extract secured from a second letter, although recording that the results were better than were at first believed, does not serve to redeem the operations from the stigma of comparative failure. Our first impulse, on reading such a statement as the result of such an expedition on such an occasion, was to repeat the famous sentence of Ruskin, "This is not failure, but disaster!" Compared with the results obtained by Mr. Warren de la Rue in Spain, in 1860; compared with those secured by the German expedition, and recorded in our pages by Dr. Vogel, such an issue as the above is most humiliating. The plates were under-exposed, and covered with spots, we are told, as though the possibility of guarding against such contingencies was a thing undreamt of. In a subsequent letter to Mr. Warren de la Rue, Major Tennant is more hopeful, and better satisfied with the results obtained. The result of the under-exposure, it is here suggested, was less injurious than was at first suspected; but the multitude of spots, from the nitrate of silver becoming "concentrated," of course nothing can remove, and their presence must seriously interfere with the value of the photographic record of the eclipse. This expedition was sent out by the Royal Society, aided by Government, and we fear very much that it is to the aid of the latter much of the failure may be attributed. It is probable, in fact, that it is due to red tape. A staff of men provided by Government might or might not be fitted in all respects for the work; but if the men "told off" for the duty knew nothing of photography, it would be against all precedent to import a photographer from another department. If the men were selected from the Engineers, and they were not familiar with photographic operations, it would be quite inadmissible to introduce amongst them men from (say) the Artillery, who were skilled photographers. It is probable, from what we can learn, that to a cause of this kind the failure in result was due. Be this as it may, however, it appears tolerably clear that no experienced photographer formed part of the expedition staff, or we should not have heard of such puerile difficulties as spots from concentrations of the silver solution. The photographic operations of the German expedition, were admirable in their systematic prevision. Possible forms of failure were anticipated and carefully provided against. The condition of the various chemicals was carefully tested, and the relative working conditions of various collodions ascertained under the precise circumstances in which they would be required. Preliminary exposures were tried on the spot. In short, everything was so well rehearsed, and every one so carefully told off to his duty, that failure from preventible causes was scarcely possible. If this expedition were distinguished by anything of military routine, it was in the efficient drill by which they prepared themselves for actual operations; whilst the one military element which was missing in the expedition in India was this effective drill. We have in this country several photographers of high repute and great practical skill who have had experience in Eastern photography, and who have succeeded amid the gravest difficulties. We refer to such men as Bedford, and Frith, and Goode. Surely it would have been possible to have secured the services of some of these or other experienced photographers to whom the purely photographic operations should have been confided, and who would have certainly secured immunity from the disasters attending concentrated silver solutions, and probably also from the risk of under-exposure.—*The Photographic News.*

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2950. R. Oxland, Plymouth, Devonshire, and J. Hocking, jun., Redruth, Cornwall, "Improvements in calcining ores and minerals.—Petition recorded September 25, 1868.

3112. T. Merz, Hebburn, Durham, and G. Thomson, Pelaw-Main, Durham, "Improvements in calcining ores, minerals, and other substances, and in furnaces therefor."—October 10, 1868.

3167. R. Pearce, Swansea, "Improvements in the separation of copper and other metals from silver and gold, the same being applicable to other metallurgical operations."

3171. W. E. Newton, Chancery Lane, "Improvements in the manufacture of syrup and sugar."—A communication from N. Pigeon, Brooklyn, New York, U.S.A.—October 16, 1868.

3203. G. Chapman, Glasgow, N.B., "Improvements in treating sewage in order to obtain valuable products therefrom."—October 20, 1868.

INVENTION PROTECTED BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

3237. A. B. Bérard, Avenue Montaigne, Paris, "Improvements in the processes and apparatuses for converting cast-iron into steel."—Petition recorded October 23, 1868.

NOTICES TO PROCEED.

2042. E. Mucklow, Bury, "Utilising refuse tanning matters for dyeing purposes."—Petition recorded June 25, 1868.

2067. J. Baggs, High Holborn, Middlesex, and F. Braby, Camberwell, Surrey, "Improvements in the extrication and condensation of ammonia, and in the manufacture of ammoniacal salts."—June 27, 1868.

2157. A. P. Price, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of phosphates of lime, and in obtaining products therefrom."—A communication from E. Pélouze and L. Dusart, Paris. —July 7, 1868.

2296. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the production of a red colouring matter."—A communication from A. Clavel, Basle, Switzerland.—July 22, 1868.

2268. C. D. Abel, Southampton Buildings, Chancery Lane, "Improvements in converting cast-iron into wrought-iron, and in uniting oxides and fluxes with molten cast-iron."—A communication from T. S. Blair, Pittsburg, Penn., U.S.A.—September 18, 1868.

TO CORRESPONDENTS.

Communications have been received from Dr. Röhrig; Dr. Oxland (with enclosure); Dr. Muspratt; H. Kynaston; W. S. Colman; W. Little; H. A. Almond; W. Thompson; E. Harvey (with enclosure); W. Robertson; J. Morewood (with enclosure); Dr. R. Angus Smith, F.R.S.; W. Baxter; C. A. Cameron; Mawson and Swan; Brooke, Simpson, and Spiller; E. P. Potter; A. C. Hadland and Co.; and J. Nadal Nye and Co.

THE CHEMICAL NEWS.

Vol. XVIII. No. 467.

SPECTRUM OBSERVATIONS CONNECTED WITH THE RECENT ECLIPSE OF THE SUN.

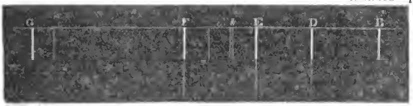
The French Minister of Public Instruction has received the following report from M. G. Rayet, who examined the protuberances spectroscopically during the total eclipse of the sun of August 18th, 1868, on the peninsula of Malacca:—

"The apparatus which I used at Wah-Tonne for the optical examination of the light of the protuberances, consisted of a telescope with a silvered glass mirror 20 centimetres in diameter, mounted equatorially for the latitude of the station, and of a direct vision spectroscope. The latter instrument, formed of three very dispersing prisms, was arranged of short length and to give much light.

"*Spectrum of the Horns.*—The slit of the spectroscope having been arranged so as to cut at right angles the image of the narrow luminous arc which would remain some seconds before total obscurity, I first examined the light from the extremity of the horns. On the ground of a spectrum with very sharp black lines formed by the diffused atmospheric light, was seen a much more luminous band, which was the spectrum of the light emitted by the extremity of the horn. Whatever was the width of this part, nothing particular could be noticed in it; the rays had an appearance in respect to width and intensity identical with those of the ordinary solar spectrum. The observation of the horns was interrupted some seconds before totality, in order to remove the diaphragms from the telescope, to slightly open the slit of the spectroscope, and thus be prepared to examine the protuberances.

"*Spectrum of the Protuberances.*—At the instant of total obscurity, the slit of the spectroscope having been brought on to the image of the long protuberance, which became visible on the eastern edge of the sun, I immediately saw a series of nine brilliant lines, which, by their arrangement in the field, their relative distance, their colour, and their general effect as a whole, appeared to be related to the principal lines of the solar spectrum—B, D, E, *b*, an unknown line, F, and two lines of the group, G. These lines possessed great brilliancy, and appeared strongly relieved from the ashy grey very pale ground.

"The protuberances are therefore jets of incandescent gaseous matter, the flames of a chemical phenomenon of extreme energy. It may also be remarked that the light of the corona is very faint in comparison with that of the protuberances; for whilst the light of the latter gave a very vivid spectrum, the corona, in spite of the rather large opening of the slit, did not give any appreciably coloured spectrum.



"During the preceding observations, the slit of the spectroscope was parallel to the principal length of the protuberance. Thus the luminous lines were seen in the apparatus of a length in proportion to the height of the protuberance; the slit having been turned 90° round, the rays appeared reduced to the appearance of brilliant points corresponding to the slight width of the luminous horn; no error of observation is therefore possible, and the brilliant lines actually represent the spectrum of the ligh of the protuberances.

"The spectroscope being in the first position (the slit parallel to the length of the protuberance) the very brilliant lines corresponding to D, E, and F, were prolonged beyond the mean length, by a very feeble luminous tract, the spectrum presenting the appearance given in the accompanying drawing. A certain portion of the incandescent gaseous light which forms the protuberances therefore spreads into the solar atmosphere beyond the limits which the eye in general assigns to these expansions.

"The examination of this first protuberance being finished, I directed the slit on to the large luminous region which was at the west of the sun. This time, also, the spectrum was seen to consist of brilliant lines arranged as in the first case, with the exception of there being only one violet line. Therefore all the protuberances do not appear to emit identical light."

On the 24th of October, the Minister of Public Instruction received the following letter, addressed to him by M. Janssen, who was commissioned to examine the phenomena of the eclipse:—

"Cocanada, September 19, 1868.

"Sir,—I have this moment come from Guntour, in the interior, where I observed with a fine sky the great eclipse of the 18th of August. A messenger starting for Bombay, I take the opportunity of sending quickly to you my views, reserving a more detailed account for the next steamer. The hospitality of the English has been worthy of its reputation. Lord Napier had me taken from Madras to Masulipatam in a steam-boat belonging to the state; another steam-boat has been placed at my disposal in the Godavery, and a sub-collector, Mr. Graham, was attached to my mission to remove all the difficulties which I might encounter in the interior, chiefly on account of the quantity of luggage which will follow me. The station of Guntoor is undoubtedly most favourable: the sky was beautiful, especially during the totality, and my powerful telescopes, of nearly three metres of focus, have enabled me to make an analytical study of all the phenomena of the eclipse. Immediately after the totality two magnificent protuberances made their appearance; one of them of more than three minutes in height shone with a splendour which it is difficult to imagine. An analysis of its light showed me directly that it was formed by an immense column of incandescent gas, principally composed of hydrogen. The analysis of the regions surrounding the sun where M. Kirchhoff places the solar atmosphere has not given me results conformable to the theory prescribed by this illustrious physicist. These results, it appears to me, should lead to a knowledge of the real constitution of the solar spectrum. But the most important result of these observations is the discovery of a method of which the principle was conceived during the eclipse itself, and which will allow of the study of protuberances and of the regions surrounding the sun at all times, without its being necessary to have recourse to the interposition of an opaque body before the sun's disc. This method is founded upon the spectral properties of the light of the protuberances—light which resolves itself into a small number of very luminous pencils corresponding to the obscure rays of the solar spectrum. The day after the eclipse the method was applied with success. I was enabled to assist at a new eclipse, as it were, which lasted throughout the entire day. The old protuberances were greatly modified; there remained scarcely any traces of the great protuberance, and the distribution ofthe gaseous matter was very different. From this day to the 4th of September I have constantly studied the sun from this point of view. I have made pictures of the protuberances, which demonstrate with what rapidity (often in some minutes) these immense gaseous masses are broken up and displaced. In conclusion, during this period, which has been like an eclipse of seventeen days, I have collected a great number of facts on the physical constitution of the sun.—(Signed) Janssen."

In our last number we gave an extract from the *Photographic News*, animadverting on the mismanagement which had caused the English attempts to photograph the eclipse to be a comparative failure. It is some consolation to find that the German photographic expedition was eminently successful, and the following graphic account, from the pen of Dr. Vogel, the photographer in chief, will show how well success was earned :—

"At the day of the eclipse we rose at four o'clock in the morning. It was the task of the North German expedition to make a photographic view of the eclipse during its totality. For this purpose we had a long telescope with a lens of 6 inches, without difference of focus, and with a focal distance of 6 feet. This lens, constructed by Steinheil, afforded a solar image of three quarters of an inch in diameter, which was taken upon a photographic plate by means of an ordinary sliding chest for two images.

"The totality of the eclipse at Aden was about three minutes long (in India five minutes); nevertheless, we had chosen Aden for our station because there were already photographic observers in India, and because the totality appeared at Aden about an hour earlier than in India. Therefore a comparison of the different results would enable us to decide the question, if the protuberances appearing at a total eclipse of the sun were changing in the course of time or not.

"Our task was now to get within these three minutes as many views of the phenomenon as possible. For this purpose we had previously exercised ourselves in the employment of the photographic telescope, like artillerymen with their guns.

"Dr. Fritsche prepared the plates in the first tent, Dr. Zenker put the sliding chests into the telescope, Dr. Thiell exposed, and I myself developed in the second tent.

"We stated that it was possible in this way to get six images (three plates of two images) during three minutes.

"When the decisive moment was fast advancing, the sky, hitherto covered with clouds, showed some openings, through which the sun, already covered partially by the moon, was to be seen. The landscape around was illuminated by the strangest light, a medium between moon and sun light.

"The chemical strength of light was exceedingly weak. A proof plate gave a wholly exposed image of the cloud after fifteen seconds. The sun crescent became smaller and smaller, and the opening in the clouds seemed to increase.

"The last minutes before the totality (which began at twenty minutes past six o'clock) went rapidly away. Dr. Fritsche and myself crept into the tents, where we remained, consequently we have seen nothing of the totality. Our work began; we exposed the first plate five and ten seconds, in order to know what was the just time.

"Muhammed, our black servant, brought the first attempt into my tent. I poured the iron developer over the plate, eager to know what was to come. At this moment my light was extinguished. I called for light, but nobody heard me, as all were about their task. I stretched my right hand out of the tent, holding the chest in the left, and happily caught a small oil lamp, which I had previously prepared. And now I saw the image of the sun appearing on the plate. The dark margin of the sun was surrounded by a series of peculiar elevations, the other side showed a strange hook; the phenomenon being exactly the same in both views. My joy was great, but there was no time for enjoyment. I soon received the second, and, after another minute, the third plate. 'The sun is coming forth!' exclaimed Dr. Zenker. The totality was over. All this seemed to have been done in a moment.

"When I developed the second plate I perceived only very weak traces of an image. The clouds had veiled the sun at the very moment of the exposure. The third plate gave two brilliant views, with protuberances at the lower margin. Glad to have reached so much, we washed, fixed, and varnished the plates, and immediately took some copies on glass, which were to be dispatched to Europe separately."

On the day of the eclipse Major Tennant wrote from Guntoor to the Astronomer Royal as follows :—

"This morning was very promising, and if it had followed the course of its predecessor we should have had a magnificent clear sky, but it clouded over the east with thin cumulostrati, which, while hardly stopping vision, interfere very much with the photographic energy; and the result was that every negative was under-exposed, and we have little more than very dense marks showing the protuberances. The six plates arranged for were duly exposed, but the heat so concentrated the nitrate of silver solution that, besides showing but faint traces of any corona, they are all covered with spots. Still we may make something of them, and will try.

"Captain Branfill reports the protuberances unpolarised, and the corona strongly polarised everywhere in a plane passing through the centre of the sun.

"Complementarily I have to report a continuous spectrum from the corona, and one of bright lines from the prominence I examined. I am, I believe, safe in saying that three of the lines in the spectrum of the protuberances correspond to C, D, and *b*. I saw a line in the green near F, but I had lost so much time in finding the protuberance (owing to the finder having changed its adjustment since last night) that I lost it in the sunlight before measuring it, and I believe I saw traces of a line in the blue near G, but to see them clearly involves a very large change in the focus of the telescope, which was out of the question then.

"I conclude that my result is that the atmosphere of the sun is mainly of non-luminous (or faintly luminous) gas at a short distance from the limb of the sun. It may have had faintly luminous lines, but I had to open the jaws a good deal to get what I could see at first, and, consequently, the lines would be diffused somewhat; still I think I should have seen them. The prominence I examined was a very high narrow one, almost, to my eye, like a bit of the sun through a chink in brightness and colour (I could see no tinge of colour), and somewhat zigzagged like a flash of lightning. It must have been three minutes high, for it was on the preceding side of the sun near the vertex, and was a marked object, both in the last photo.-plate just before the sun reappeared, and to the eye.

"Captain Branfill saw the prominences coloured, as did two other gentlemen; but one in my observatory (like myself) only saw it white. I should, however, say that for long I never saw *a* Orionis markedly red, nor Antares, and I may not catch red soon, though I cannot conceive this being so.

"In conclusion, I may note that the darkness was very slight, and the colour not half so gloomy as in the eclipse of 1857, which was partial at Delhi, where I was then."

Five days after writing the above, Major Tennant wrote to Dr. Warren De la Rue as follows :—

"I did myself the pleasure of sending Mr. Airy a report, such as I could hurriedly make, upon the 18th, of what we had seen and done. Since then we have been enlarging the photographs, and I am very well satisfied. The clouds reduced the actinism very much and very unequally, but that has shown new things to me. 1st. There is very little corona. 2nd. The cloudy structure of prominences is very marked. But the most remarkable thing is a great horn, which seems to have been 3' 20" nearly high. I have, as I told Mr. Airy, clearly seen in its spectrum, C, D, and *b*, and I believe I saw F, but did not identify it. Now this shows both in Nos. 1 and 3 (photographs) as a ribbon of light, coiled spirally round a semi-transparent centre. It is very beautiful, and marked in 3, which was taken two minutes after the (commencement of) totality, and I am doing my best to keep this feature (to retain this feature) in the copies. No. 1 was taken apparently before the last of the sun went. Phillips (one of his assistants) says it was, and there is a spot of fog such as would be the result. There is a fine line of light seen through all this fog much brighter than the corona. This, too, I am keeping on enlarging. We have got six enlarged positives about 2½ inches in diameter from each negative. Every one of these shows the same remarkable spiral structure in the great horn. I find there are traces in a drawing which Dr. Janssen got made of that prominence (mentioned in the first part of his letters as invisible to the eye) of which I spoke. The positive copies I will enlarge to nine inches."

The following communication was addressed by Lieut. John Herschel, R.E., to Mr. Huggins, F.R.S., and is dated Belgaum, Aug. 25th:—

"The week preceding the event had quite prepared me for disappointment. There seems to be an annual cloudy and rainy season at Jamkandi, which lasts about a fortnight, and was said to be somewhat later and more marked than usual this year. The morning broke, however, as usual, clear, but the driving monsoon clouds soon showed the kind of sky we were to expect. About a quarter of a minute before totality a thick cloud obscured the sun. I had placed the slit (of the spectroscope) so as to cross the crescent at about the vanishing point of the limb, and was watching the narrow solar spectrum grow rapidly narrower. You may conceive the state of nervous tension at this moment. Whatever the corona was competent to show must in a few seconds have been revealed—unless, indeed, it should so happen that a prominence should be situated at that precise spot, in which case the double spectrum would be presented. But the solar spectrum faded out while it had still appreciable width, and I knew a cloud was the cause. I went to the finder, removed the dark glass, and waited—in that fever of philosophical impatience which recognises the futility of irritation, even while it chafes under the knowledge of fleeting seconds—how long I cannot say, perhaps half a minute. I can well recall the kind of frenzied temptation to turn screws and look somewhere else, checked by the calm ticking of the clock telling of a firm hold of the right place, cloud or no cloud. Soon the cloud hurried over, following the moon's direction, and, therefore, revealing first the upper limb, with its radiating and, as I fancied, scintillating corona, and then the lower limb. Instantly I marked a prominence near the needle point in the finder. A rapid turn of the tangent screw covered it with the point of the needle. Those few seconds of unveiling were practically all that I saw of the eclipse as a spectator. With the exception of a hurried glance into the finder at a later period to watch for another break, I was the whole time engaged at the spectroscope. I have not the remotest idea from actual experience of the external phenomena which were present to the thousands of upturned faces whose voices I heard outside. I might easily have lifted the curtain and looked out while the clouds were obstructing. That I did not do so is only to be explained by the absence of mind, as regarded all else, produced by the concentration of attention on the problem before me. To return: the instant the prominence was under the needle point I returned to the spectroscope. A single glance solved the problem in great measure. Three vivid lines—red, orange, blue! No others, no trace of a continuous spectrum. I think I was a little excited about this time, for I shouted quite unnecessarily to my recorder, 'Red, green, yellow,' quite conscious of the fact that I meant orange and blue. I lost no time in applying myself to measurement. And here I hesitate; I have no idea how those five minutes passed so quickly. Clouds were evidently passing continually, for the lines were only visible occasionally. The red must have been less vivid than the orange, for after a short attempt to measure it I passed on to secure the orange, and, succeeding to my satisfaction, tried for the blue line. Here I was less successful. The glimpses of light were rarer and feebler, the line itself growing shorter and further from the cross. I did, however, place the cross very near the true position, and got a reading just as the re-illumination of the field of view informed me that the sun had reappeared on the other limb. I consider there can be no question that the orange line was identical with D (sodium), so far, at least, as the instrument is competent to establish an identity. I also consider that the identity of the blue line with F (hydrogen) is not established; on the contrary, I believe the former is less refracted than F, but not much. With respect to the red line, I hesitate much in assigning an approximate place. It might have been near C (hydrogen). I doubt its being so far as B, but there would be its limits. The corona may have projected a spectrum of some kind, but I saw none. I therefore conclude it was a faint solar spectrum, a conclusion in accordance with other characteristics of the phenomenon, but especially with the (flickering?) radiating appearance, and with the satisfactory determination by Lieutenant W. M. Campbell, R.E., of the conditions of polarisation obtaining in the corona. At present it is sufficient to state that these observations leave no doubt that the light of the corona is polarised in places passing through the sun's centre. I have had no communication with any other observers since the event. I am curious to learn how far our results will corroborate each other."

Captain C. T. Haig, R.E., who observed the eclipse at Beejapoor with a hand spectroscope, has forwarded a communication to the President of the Royal Society, from which we extract the following:—

"I may state at once that I observed the spectra of two red flames close to each other, and in their spectra two broad bright bands quite sharply defined, one rose-madder and the other light golden. These spectra were soon lost in the spectrum of the moon's edge just before emergence, which had also two well-defined bright bands (one green and one indigo) about a quarter the width of the bands in the spectra of the flames, this spectrum being again soon lost in the bright sunlight."

"While the obscuration was increasing, Captain Tanner, during the few peeps we got at the eclipse, made drawings of the sun's spots, and sketched the mountains on the moon's edge, of which there were two plainly visible even with my small theodolite. The darkness increased very slowly till just before totality, when the increase was very rapid and sudden, and a general spontaneous exclamation 'Oh!' from all of us gave Mr. Kero Laxuman the time of beginning of totality, which he recorded as 9h. 1m. 49s. The eclipse was at that time completely shut out from our view by the clouds—nimbi low down being carried past by the high wind; we therefore felt at leisure to make our remarks on the degree of the darkness, which we were surprised to find so far from total. We could easily write, read our writing, and read the seconds of our watches without the aid of artificial light. We were all lamenting our misfortune in not being able to observe the eclipse, and had given up all hope of witnessing the phenomena we had come so far to see, and Captain Tanner had just noticed the faint reappearance of light in the west, when, contrary to all expectation, and to our intense satisfaction, a sudden opening in the nimbi showed us the eclipse through the cirrocumuli. We were each at our telescopes in an instant. I immediately saw through the naked telescope of the small theodolite that red flames were visible, and at once pointed the spectroscope, using the theodolite telescope as a rest. Very fortunately I directed the spectroscope with its 'refracting edge' tangent to the moon where two red flames were protruding, separated from each other by a small interval; so that their spectra, which were identical, were extended over the dark background of the moon's disc, and stood out in most marked and brilliant contrast with the feeble but continuous spectrum of the corona; and in their spectrum there were the two broad bright bands I have above described. Most fortunately, also, these red flames were on that part of the sun which first reappeared; so that just before or just *at* emergence there appeared at the very part I was intently observing one brilliant wide spectrum with the green and indigo bands before described, remaining visible for an interval just long enough to enable me to make quite sure of the position of the bands, which were then obliterated by the bright light of the sun. Of course, observing with the spectroscope alone it would have been impossible to say whether the spectrum with the green and indigo bands appeared just before or just after emergence; but I think it must have been just before, because Captain Tanner called out when totality was over; and I immediately remarked that I thought he was rather late, but he was quite confident about the accuracy of his observation. What struck me as being very remarkable was the circumstance, that though the light of the red flames was to the naked eye so feeble as to be outshone to extinction by that of the corona, nevertheless, when viewed with the spectroscope, the spectrum of the corona was very weak, and that of the flames remarkably brilliant. On the first glimpse of the eclipse, before looking through the telescope, the corona appeared so bright that it gave me the momentary impression (as it did to Captain Tanner) of its being an annular eclipse. We are divided in our estimate of the length of the interval during which we observed the totality. It appeared to me very short—so much so, that when it was over I was quite taken by surprise to hear that both Captain Tanner and Mr. Kero Laxuman had taken sketches of the flames; and their sketches, both as to position and structure, were, with one slight exception, remarkably coincident. From the time of my first pointing the spectroscope to the bursting out of the sun's light I never once withdrew my eye, though it had been my intention to shift the prism-cap on to the telescope of the theodolite as soon as I should have carefully noted the spectrum of the flames; but while I was intently gazing on the two bright bands to impress their colour well on my memory, the new spectrum of the moon's edge appeared, so that I was under the impression that the length of the time of observation was very short. On the other hand, Captain Tanner, judging from the amount of work he did in the time, estimated it at a minute. Mr. Kero Laxuman estimated it at 40 or 45 seconds. Immediately after the totality was over we all three made rough notes of our observations; and Captain Tanner's and Mr. Kero Laxuman's notes agree together wonderfully in their description of the structure of the flames."

"'The following is an extract from Captain Tanner's notes, taken almost immediately after the eclipse:—'I at first saw three prominences—one long curved pointed tongue, and two close together, straight but flat-topped, about two-thirds the height of the former. They were of a rose-madder colour, and were decidedly more like flames than anything else, not only in their general appearance and colour, but by their being composed of smaller tongues of flame parallel (or nearly so) to the general axis of the flame, so that they had a streaky appearance and a ragged edge. At the first glance, when the sun was somewhat obscured by clouds, I thought they were homogeneous and had hard edges; but this idea was at once dispelled when the clouds cleared off. The two protuberances, which were close together, were not, as far as I could see, joined by any smaller shots of flame. I afterwards observed one small protuberance, and marked the position of it in my sketch. I did not observe that it was streaky, as the others were—perhaps on account of its being so small, and perhaps because I had not sufficient time to examine it properly. As regards the corona, when we first began to see the eclipse through the clouds, I was under the impression that the eclipse, instead of being total, was only annular, so bright was the corona near the moon's limb. I could not detect any irregularities in the structure of the corona, but the light appeared to be gradually shaded off all round."

"There is a curious coincidence which I may here mention, though I imagine it can only be regarded as purely fortuitous, viz., that the flames were almost exactly opposite the spots on the sun's disc."

J. N. Lockyer, Esq., has forwarded the following letter to the Secretary of the Royal Society:—

"October 20, 1868.

"Sir,—I beg to anticipate a more detailed communication by informing you that, after a number of failures, which made the attempt seem hopeless, I have this morning perfectly succeeded in obtaining and observing part of the spectrum of a solar prominence. As a result I have established the existence of three bright lines in the following positions:—

I. Absolutely coincident with C.
II. Nearly coincident with F.
III. Near D.

"The third line (the one near D) is more refrangible than the more refrangible of the two darkest lines by eight or nine degrees of Kirchhoff's scale. I cannot speak with exactness, as this part of the spectrum requires re-mapping. I have evidence that the prominence was a very fine one. The instrument employed is the solar spectroscope, the funds for the construction of which were supplied by the Government-Grant Committee. It is to be regretted that its construction has been so long delayed.—I have, &c.,
J. Norman Lockyer."

Mr. B. Stewart, writing to the *Athenæum*, speaks of this discovery as follows:—

"A few days since I received the following note from Mr. Lockyer, dated the 20th of October, who had already communicated his discovery to the Royal Society: 'Got a prominence with the new spectroscope: got the positions of three lines; one corresponding to C absolutely, one to F very nearly, one eight or nine degrees of Kirchhoff's scale more refrangible than the most refrangible D line.' Recognising the importance of this announcement, I immediately sent an account of it to Mr. De La Rue, who was in Paris, and who communicated the notice to the Academy of Sciences. M. De Launay, to whom the communication was made, immediately replied as follows: 'I thank you for the new and interesting observation which I have just received, and which I shall be happy to communicate to the Academy of Sciences at their next meeting. Some minutes after I received your note a letter reached me from M. Janssen, who went to India to observe the eclipse of the 18th of August from the spectroscopic point of view. I will communicate his letter to the Academy also at the next meeting.'

"Here, then, we have a very marked instance of two observers, quite independently of each other, observing the same fact with certain differences. M. Janssen, it will be noticed, declares for hydrogen, but names no lines; he considers the bright lines as coincident with the dark lines of the spectrum. Mr. Lockyer, however, has not obtained this coincidence—in fact, in a further communication received from him, he lays stress on the want of complete coincidence except in one case, without in the meantime attempting to interpret the cause. Probably his spectroscope is more powerful than that of M. Janssen. But for this point, and doubtless many others, we must wait for the promised detailed communication to the Royal Society. These differences of fact, while they render the problem of great scientific interest, are not the only differences which ought to be borne in mind. Although the priority of observation is due to M. Janssen, yet the possibility of the discovery was suggested by Mr. Lockyer more than two years ago, and to my knowledge he has been working at it since that time; whereas M. Janssen frankly acknowledges that the idea only occurred to him during the eclipse itself. This fact was very nobly referred to by M. Faye, at the discussion which followed the announcement of the discovery at the Academy of Sciences."

The following remarks, condensed from the *Saturday Review*, give a few more details of Mr. Lockyer's discovery:—

"Another stride in advance has to be recorded in solar physics—perhaps at this moment the most progressive department in science. Though much more detailed knowledge probably remains to be reached by prolonged observation, we may say broadly that the spectroscope has now revealed the nature of solar prominences—the red flames of the eclipse—just as two years ago the same beautiful method solved the sun-spot problem, and not long before settled the vexed question of the constitution of nebulæ. Solar science belongs essentially to our own time. The ancient faith that the great luminary was a sphere of inconceivable brightness and spotless purity was, it is true, rudely disturbed two centuries and a half ago, when Galileo and his contemporaries observed that the solar disc was subject to eruptions of dark spots long supposed to be opaque clouds or solid bodies hiding a portion of the incandescent surface. But nearly 150 years elapsed before Wilson's discovery that the spots were cavities in the photosphere (a discovery now absolutely confirmed by the modern observations of Mr. De la Rue and others), and then another century passed before it was ascertained why these cavities looked dark, and what was the nature of the disturbances which produced them. This has been the work of the last few years. Two rival theories for a short time struggled for pre-eminence. One of these, due to M. Faye, explained the phenomenon by supposing that the mass of the sun was composed of nebulous matter too much disorganized by its excessive heat to shine with much brilliancy, while the light was due to the partial condensation of the vaporous surface into incandescent particles in the cooler photosphere. A spot, according to this view, was produced by an up-rush of the superheated and less brilliant vapour through the photosphere. The other theory was supported by three English astronomers—Mr. De la Rue, Mr. Balfour Stewart, and Mr. Lœwy—who had been making diligent solar observations at Kew. Their theory was based on the established fact, that while the bright photosphere full of incandescent particles envelops the sun, the photosphere itself is in its turn surrounded by an absorbent atmosphere; and they held that a spot was produced by a down-rush of this atmosphere into the region of the photosphere. Partly by displacing and partly by obscuring the photosphere, the whirlwind of atmosphere, according to this view, darkens the cavity of the spot. Much evidence was accumulated in favour of the English theory, but it was not conclusively established until the year 1866, when Mr. Lockyer applied to the investigation the same method of spectrum analysis by the aid of which Mr. Huggins had a short time before ascertained the constitution of nebulæ."

"In the same paper in which Mr. Lockyer announced his solution of the sun-spot difficulty, he suggested the pertinent question whether the spectroscope might not afford us evidence of the red flames which total eclipses had revealed. The question was not a mere barren conjecture, for Mr. Lockyer employed the spectroscope, which he had mounted for the examination of sun-spots, in diligently sweeping round the edge of the sun in search of such special spectrum as the prominences might give. From the year 1866 these observations were continued without result, and another observer, Mr. Stone, who afterwards commenced a similar search, was equally unsuccessful; but at length, in the early part of the present month, a spectroscope of much greater power was mounted, and Mr. Lockyer was soon rewarded by a sight of the prominence-spectrum, which, so far as the observations have yet gone, appears to consist of three bright lines—one corresponding exactly to the dark line C in the red portion of the solar spectrum, which is commonly considered to be due to hydrogen; another nearly coinciding with the line F at the confines of the blue and green, which is also ascribed to hydrogen; and a third, at a little distance from the conspicuous sodium lines D, but clearly distinct from them, and, curiously enough, without any corresponding line which has yet been noted in the solar spectrum.

"Before this result was achieved and communicated to the Royal Society, the eclipse had taken place, and several observers had gone to India and other places within the region of totality, armed with apparatus for the examination of the prominence-spectrum. All of these observers had reported that they got a spectrum composed of bright lines alone—the evidence of burning gas; but, either from the necessary hurry attendant upon observations during the few minutes allowed by the period of total obscuration, or from some other cause, the most remarkable discrepancies appeared in the positions assigned to the lines. Captain Herschel, who represented the Royal Society, reported three lines—one absolutely identical with D, another not quite agreeing with F, and the third somewhere near B or C. Major Tennant, who went to Guntoor, in India, on behalf of the Royal Astronomical Society, reported three lines, C, D, and *b*—this last being in a region where no other observer except M. Rayet saw any line at all. M. Rayet, who was at Wha-Tonne, considered that he detected as many as nine lines—B, D, E, *b*, another unknown line, two of the lines about F, and the line G. It will be observed that nearly all the lines named by these observers are given as actually corresponding with known solar lines. M. Janssen, who represented the Académie des Sciences and the Bureau des Longitudes, reports the hydrogen lines as the principal lines. As yet the detailed accounts from these observers have not been received; but it seems probable, from the uncertainty with which the position of some of the lines is spoken of, and the wide discrepancy between the results of different observations, that the lines were determined, for the most part, rather by estimate than by measurement. Although, therefore, the eclipse observations had removed all doubt as to the gaseous nature of the prominences, and thus anticipated the result obtained by Mr. Lockyer, the discovery that the spectrum of the prominences might be observed at any time rendered it possible to ascertain the exact position of the lines with a precision which was far from being attained in the observations made during the eclipse. Scarcely, however, had it become known that the search for the prominences had at last proved successful, when a letter arrived in Paris from M. Janssen, stating that, while making his eclipse observations it occurred to him that he ought to be able to see the prominence-spectrum without calling the moon in aid to relieve him from the brightness of the sun. Accordingly, before returning from Guntoor, he had made the attempt, and succeeded in getting several views of the prominence-spectrum some weeks before Mr. Lockyer had achieved the same result in England. It has often been remarked how frequently scientific discoveries are made by independent observers at the same time, and perhaps the coincidence was seldom closer than in this instance. The French observer was the first who actually caught sight of the coveted object, but the Englishman had been the first by a year or two to suggest and commence the search, and was the first to publish his discovery. His results were announced to the Royal Society, and by Mr. De La Rue to the Académie des Sciences, before the arrival of M. Janssen's letter, which, singularly enough, was delivered to the President of the French Academy a few minutes after a more detailed announcement of the English discovery had been received by him.

"M. Janssen's letter, which appeared in the *Moniteur* of the 25th instant, state that the prominences are principally composed of hydrogen, a result which, as to the line C, entirely agrees with Mr. Lockyer's. We shall wait with interest to see whether, on the receipt of the more complete report which M. Janssen as well as Mr. Lockyer promises, his conclusions will be found in other respects to agree absolutely with those of the English astronomer; but it is scarcely likely, from the nature of the process, that there should be any discrepancy. One observer may possibly, by devoting himself too exclusively to one part of the spectrum, miss a line which another detects; but, with the method of observation devised by Mr. Lockyer, a line which is once seen cannot well be assigned to a wrong place. The spectroscope being directed to the edge of the sun shows in the field of view a narrow belt of the true solar spectrum, and beyond this comes the fainter spectrum of the sun's atmosphere, in which the prolongation of the dark lines is visible. When a prominence is reached, as the instrument sweeps round the sun, the bright line flashes out, sometimes overlapping both the spectrum of the sun and that of the atmosphere, and at other times entirely within, and then again at some distance beyond, the edge of the sun; these variations depending of course on the form and position of the prominence, and affording, as both M. Janssen and Mr. Lockyer at once pointed out, the means of tracing an actual outline of the prominence observed. Whenever, therefore, a bright line is seen, it shows itself superimposed upon the actual solar scale, and any error in assigning its position would be inconceivable. Where the line actually corresponds to a dark line it appears sometimes as striking out the black line from the bright solar spectrum, at others as prolonging it with a line of light. Both these appearances were strikingly exhibited with the line C, when we had the privilege of observing the spectrum through Mr. Lockyer's instrument; and the extreme clearness with which the line near D came out disposed in a moment of the idea, apparently entertained by some of the observers in India, that the two were identical. Whatever this bright line may be, it is certainly not a sodium line. At present it is not certain that all the lines of the new spectrum have been fixed, and it is just conceivable that one prominence might be wanting in a line disclosed by another at a different region of the sun. But there seems reason to believe that the three lines already established form, at any rate, the principal part of the spectrum, and that these were the three lines in fact seen by most of the observers, although their positions are so differently estimated. Whether M. Rayet's nine lines will ever be confirmed by the more exact and deliberate mode of observation now shown to be available, seems doubtful. It is not, however, worth while to speculate on matters which a prolonged course of observation will translate into the region of ascertained facts; and we may be sure that the prominence-spectrum—now that it has once been caught—will not be left alone till it has given up all the knowledge which it has to communicate, much of which we hope to hear about at the next meeting of the Royal Society."

ON THE

DETERMINATION OF SILICON, GRAPHITE, AND MANGANESE IN IRON AND STEEL.

By Prof. V. EGGERTZ.
School of Mines, Fahlun, Sweden.

Silicon, Graphite.—To 4 c.c. of sulphuric acid are added 20 c.c. of water in a beaker of 100 c.c. capacity, and when the heat produced by the combination of the water and the acid has entirely disappeared, 2 grammes of pig-iron finely powdered are shaken into the diluted acid and boiled for half an hour. (For steel and wrought-iron not less than 3 grammes should be taken, and the acid for solution added in the proportion shown above for pig-iron). The solution is then evaporated until it measures 18 c.c., allowed to cool down the temperature of 50° C., and 4 c.c. of nitric acid sp. gr. 1·20 added, boiled for a quarter of an hour, and allowed to evaporate on a water bath, until, on holding a watch glass over the beaker, there occurs upon it no perceptible condensation. To the dry mass add 30 c.c. of water and 5 c.c. of hydrochloric acid sp. gr. 1·16, boil for a quarter of an hour, and add more hydrochloric acid if there appears to be anything besides silica and graphite undissolved in the solution. The insoluble silica and graphite are thrown on a filter, which has been dried at 100° C., and carefully weighed, washed with cold water until the washings give no iron reaction when tested with ferrocyanide of potassium; then washed with boiling water containing 5 per cent of nitric acid, taking care not to allow the acid water to enter the filtrate in which the manganese is to be estimated. The silica and graphite are then dried on the filter at 100° C., and weighed, ignited in a porcelain crucible, and the weight carefully taken. The difference between the weighings before and after ignition gives the amount of the graphite. After ignition the silica should appear quite white, any trace of red colouration showing it to be contaminated with iron. The percentage of silicon in the silica is 48.

Manganese.—The filtrate from the silica is diluted with water until it measures 400 c.c., and accurately divided into two portions of 200 c.c. each, one of which is set on one side, and in the other the manganese is estimated in the following manner. (In the case of wrought-iron and steel, where 3 grammes are taken, the solution is diluted to 200 c.c., and the manganese estimated without divided the solution). A saturated solution of carbonate of soda is added to the manganese solution until it becomes nearly neutralised, appearing of a deep brown colour; water containing 5 per cent of carbonate of soda is then added drop by drop until a slight turbidity occurs in the solution; and if on standing in the cold this turbidity rather increases than diminishes, sufficient soda has been added (if too much soda has been added, and a precipitate is thrown down, the excess of soda must be neutralised by hydrochloric acid); to the slightly turbid solution 1½ c.c. of hydrochloric acid is added, and heated on the water bath until the solution becomes clear; dilute with about half as much water as the volume of the solution, and add 30 c.c. of a saturated solution of acetate of soda, boil for a quarter of an hour, allow the precipitated iron to settle, and decant the clear liquid through a filter, washing the iron by decantation with boiling water containing ½ per cent of acetate of soda; finally throw the iron on the filter, and continue the washing until bromine water gives no reaction, showing that all the manganese has passed through the filter; evaporate the filtrate down to 400 or 500 c.c., and at the temperature of 50° C.; add a few drops of bromine to precipitate the manganese, and keep it about that temperature for twelve hours, stirring occasionally with a glass rod; the solution after addition of the bromine becomes of a yellow or brownish colour, but should be perfectly colourless before filtering. The manganese is now thrown on a filter which has been dried at 100° C., and accurately weighed, washed with cold water containing 1 per cent of hydrochloric acid, dried at 100° C., and weighed. The precipitate is a hydrated oxide of manganese containing 59·21 per cent of manganese, or precipitate may also be ignited in a porcelain crucible at a white heat, and is then an anhydrous oxide of manganese containing 72·05 per cent of manganese.—*Engineering*.

ON THE

PRODUCTS OF THE ACTION OF SULPHIDE OF AMMONIUM UPON STRYCHNINE.

By Professor HOW, D.C.L., Windsor, Nova Scotia.

A very interesting paper, by Dr. A. W. Hofmann, announcing the existence of a compound of persulphide of hydrogen and strychnine, was lately given in abstract in this Journal (No. 453, August 7, 1868). My object in referring to it is to point out that some substance is probably formed in the reaction by which the compound is obtained which has not yet received examination. The process employed is one by which, as I showed in 1855, (*Edin. New Phil. Journ.*, Jan., 1855, p. 47), the hyposulphites of some of the alkaloids are readily formed. It consists in digesting the alkaloids with sulphide of ammonium with free access of air. In conducting this operation with strychnine, I found, as first mentioned in

1854, in a paper "On the Action of the Halogen Compounds of Ethyl and Amyl on some of the Vegetable Alkaloids" (*Trans. Royal Soc. Edin.*, xxi., p. 33), that a substance was produced evidently different from the hyposulphite of strychnine, a white salt crystallising in rhomboidal plates, formed at the same time. It was doubtless the compound recently examined by my illustrious master, and possibly I should have made out its nature had I remained in an atmosphere more scientific than that into which my fate led me soon after my account of the hyposulphites referred to above was written. The compound,

$$C_{21}H_{22}N_2O_2.H_2S_3,$$

of Hofmann, is described as giving beautiful needles, of an orange colour, completely insoluble in water, alcohol, ether, and sulphide of carbon. In my notes of the experiments relating to the hyposulphites, I find mention of "stars of yellow crystals," and "yellow red stars," being deposited on the walls of the vessel containing strychnine, alcohol, and aqueous sulphide of ammonium. There can be very little doubt of the body alluded to by myself in 1854 being identical with the compound in question, for the knowledge of whose composition we are indebted to Dr. Hofmann. It does not, however, appear that this is the only product of the reaction besides the hyposulphite of strychnine, for I find in the same notes mention of a yellow substance which "dissolved in hot rectified spirit and gave a semi-crystalline deposit on cooling." Again, in the description of the action of sulphuretted hydrogen on the carbonate of ethylostrychnine, I state (*Edin. New Phil. Journ.*, Jan. 1855, p. 55), "Hyposulphite of ethylostrychnine may be obtained by passing sulphuretted hydrogen into the carbonate of the base, and allowing the liquid to stand exposed to a moderate heat. It is, however, in this case accompanied by a product which, to judge from appearances, is the same as that formed by the action of sulphide of ammonium upon strychnine. This substance has a yellow colour and is of extreme solubility in spirit, and nearly insoluble in water."

Hence it appears that there are two yellow bodies formed, one only of which is as yet fully made out. I mention this because some chemist may be induced to take up an investigation which promises interesting results. I may add that I began to examine the action of sulphide of ammonium on strychnine, as mentioned in one of the papers referred to above, in the hope of ascertaining the function of the second atom of nitrogen. I was rewarded by making the acquaintance of the hyposulphites of the alkaloids, indeed, but by no definite results on the point in question; such as I obtained are now given, and I wish success to any one who chooses to take up a problem which I shall most probably never again attempt to solve.

ON A MODE OF EXTRACTING THE METALS MOLYBDENUM AND CHROMIUM.

By J. ENEU LOUGHLIN, M.D.

MOLYBDENUM was first prepared by Hjelm in the year 1782. His method consisted in heating the trioxide of molybdenum in a porcelain crucible for two or three hours. Several other methods have since been used, prominent among them being that of heating the acid molybdate of potassium; also the reduction of molybdate of ammonium by heat, or the reduction of trioxide of molybdenum by carbonate of soda. Molybdenum is described as a silver-white metal, not altered by contact with air at ordinary temperature. Sp. gr. 8·5; not attacked by chlorhydric acid or dilute sulphuric acid. Strong sulphuric and nitric acids, on the contrary, act very powerfully upon it with evolution of sulphurous acid and hyponitric acid. Having had occasion during June, 1867, to use some molybdenum, I tried the methods above stated; they were all very satisfactory as regards the yield of pure metal, but the time was rather long. I then had recourse to the reducing action of cyanide of potassium. Molybdic acid was prepared and tested according to Fresenius[*]. The result being satisfactory as regarded the purity of the molybdic acid, 10 grains of molybdic acid thus prepared were mixed with 15 grains of cyanide of potassium placed in a porcelain crucible, which porcelain crucible with the lid luted was placed in another crucible, then surrounded by powdered animal charcoal and exposed to a white heat for twelve minutes. At that time the crucibles were removed, allowed to cool, and examined; the porcelain crucible was found lined with a brilliant silver-white metal of a sp. gr. 8·56, which was not attacked by chlorhydric acid, but violently attacked by nitric acid with evolution of hyponitric acid fumes; it reduced oxide of mercury and oxide of silver when triturated with these substances. An analysis of this showed it to consist of—

Molybdenum	98·7
Impurities, SiO_2, C	1·3
	100·0

By the same process, using sesquioxide of chromium in place of molybdic acid, chromium was obtained, possessing a sp. gr. 6·2. The best results were procured by using a reducing mixture of cyanide of potassium and animal charcoal.—*American Journal of Science*, July, 1868.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 5, 1868.

Dr. W. A. MILLER, V.P.R.S., &c., Vice-President, in the chair.

THE minutes of the previous meeting were read and confirmed. Among the donations to the library which were announced was the valuable present made by Mrs. Warington of eighty volumes from the library of her lamented husband, the late Professor Warington. They consist chiefly of works which belong to the history of chemistry, and not the least important of them is a copy of Agricola's celebrated treatise "De re Metallica."

The following names of candidates for admission into the Society were read by the secretary:—For the first time—Mr. E. G. Tosh, Ph.D., Mr. G. R. Gowland; for the second time—Dr. W. J. Balmer, surgeon to the Bengal Army.

The CHAIRMAN, then addressing the Society, stated that the council had for some time been desirous of increasing the number of Fellows who took part in the business of the Society, but that they had met with some difficulty from the restrictions imposed upon them by the charter, which limited the number of the council to twelve. They found, however, that the charter did not define the number of the vice-presidents, and they therefore suggested that the list of vice-presidents should be increased by two.

For the purpose of discussing this proposal and altering the 5th and 7th by law, the chairman summoned the Fellows of the Society to a general meeting to be held on Thursday, November 19th, at eight o'clock.

The first paper read was by Mr. W. H. Perkin, "*On the Hydride of Butyro-Salicyl and Butyric-Coumaric Acid.*" This paper is published in full in the current number of the Society's journal, and we may therefore content ourselves with a brief abstract of it.

The author's previous communications had shown that hydride of aceto-salicyl, H,C_7H_4O,C_2H_3O,O, is an intermediate stage in the formation of coumarin from acetic anhydride and hydride of sodium-salicyl. By the substitution of other anhydrides for the acetic, he had obtained homologues of coumarin, and he now describes the hydride of butyro-salicyl, which forms the intermediate stage in the synthesis of butyric coumarin, as hydride of aceto-salicyl does in that of ordinary coumarin.

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[*] *Amer. Journ. Sci.*, pp. 179, 180, Qualitative Analysis.

It is an oil boiling at 260°-270° C. Hydrate of potassium decomposes it into hydride of potassium-salicyl and butyrate of potassium, and it yields with acetic anhydride a compound ($C_9H_8O_3,C_4H_6O_3$) perfectly parallel with those produced by the action of the anhydride on the hydrides of ethyl-salicyl, aceto-salicyl, &c. When boiled with butyric anhydride and butyrate of sodium it yields butyric coumarin.

By the action of hydrate of potassium, butyric coumarin yields butyric-coumaric acid, a true homologue of ordinary coumaric acid, and like it capable of yielding only monometallic derivatives.

"*On the Application of Chlorine Gas to the Toughening and Refining of Gold*," by F. B. Miller, F.C.S., Assayer in the Sydney branch of the Royal Mint.

The methods now in use for effecting the above purposes are all more or less unsatisfactory, and the author has therefore devised a process which appears to satisfy all the requirements of the case in a single operation.

A French clay crucible is saturated with borax by immersing it in a hot saturated solution, and drying. The gold is then melted in this crucible with a little borax, and a stream of chlorine gas is allowed to pass through it by means of a clay tube (a tobacco-pipe stem was found suitable). The chlorine generator is fitted with a safety tube 7 feet long, and is connected with the clay tube by a caoutchouc tube. In a few hours the whole of the silver is converted into chloride, which floats on the gold. The borax prevents the absorption of the chloride by the crucible, and also its volatilisation, except in very minute quantities. As soon as the gold has become solid, the still liquid chloride of silver is poured off, and the gold is now found to have a fineness of say 993 parts in 1,000. The apparent loss of gold is very little greater than is found in ordinary gold melting—being 2·9 parts in 10,000—whereas in the ordinary process it is 2. A small sample of the gold is removed from time to time during the operation by means of a piece of tobacco-pipe used as a pipette. This is rapidly assayed approximately, and thus the progress of the operation is judged of.

The fused chloride of silver obtained as a slab after the operation, is reduced by placing it between two plates of wrought-iron in a bath of dilute sulphuric acid. The spongy silver so obtained contains gold, which may be separated by nitric acid. The nitrate of silver can of course be precipitated as chloride, and subsequently reduced. The gold appears to be present in the chloride of silver in the form of a double chloride, and the author has succeeded in separating it directly from this combination by precipitation by metallic silver.

The Chairman, in proposing a vote of thanks to the author, remarked upon the great importance of the new process. Much of the gold imported into this country contained 60 or 70 ounces of silver in 1000, which could not at the present time be profitably extracted. The new method would probably be soon adopted by English assayers.

Mr. Forbes had listened to the reading of the paper with great pleasure. It had hitherto been supposed that the volatility of chloride of silver was too great to allow of such a method of separation being adopted, but the author's experiments seemed to leave no doubt that borax would prevent the volatilisation.

Professor Foster remarked that the action of borax in this case probably consisted in its shutting out the atmosphere. The chloride of silver could not evaporate without an atmosphere into which it could diffuse itself. Dr. Matthiessen, in some of his experiments, made use of fused paraffin for the same purpose—viz., to avoid evaporation.

"*Note on the Specific Gravity and Boiling-point of Chromyl Dichloride*," by T. E. Thorpe, Dalton Scholar in the Laboratory of Owen's College, Manchester. The author prepared the liquid by distilling an intimate mixture of 10 parts sodium chloride and 12 parts potassium dichromate with 30 parts strong sulphuric acid. He removed the free chlorine by repeated distillation in an atmosphere of carbonic acid. The specific gravity of the liquid so obtained was, at a temperature of 25° C., 1·92. Walter, whose previous determination is quoted by the author, found 1·71, but this number is rendered impossible by the fact that the pure liquid sinks when dropped into strong sulphuric acid.

The boiling point, at a pressure of 733 millimetres, was found to be 116·8. Walter, at a pressure of 760 millimetres, found 118°. Allowing for the difference of pressure, these two observations agree completely. The dichloride cannot, however, be distilled without some slight decomposition.

"*Analysis of the Ashes of a Diseased Orange Tree* (*Citrus Aurantium*), by T. E. Thorpe.

The orange plantations along the south-eastern coast of Spain, and in the adjacent Balearic Isles have recently been visited with a severe epidemic, the rapid progress of which was naturally viewed with no little anxiety by the people, since the culture and exportation of oranges constitute one of their principal industries. The origin of the disease is involved in complete obscurity, and as yet it has baffled all attempts at remedial measures. The first symptoms are observed in the leaves, which turn yellow and drop off; a most disgusting odour exhales from the roots, and in a few days the tree succumbs. The violence of the disease is now, happily, much abated, and it appears to be dying out.

Professor Bunsen, who visited the Balearic Isles during the summer vacation of last year, collected specimens of various parts of the diseased plants, and the author has analysed the ashes of them under his direction in the laboratory of the University of Heidelberg.

The method of analysis is first described. The caustic bases were first converted into carbonates by treatment with CO_2 in a stoppered glass cylinder, the whole evaporated to dryness, treated with a small quantity of water, and the insoluble separated from the soluble portion by means of a weighed filter. Separate analyses of each were made. The phosphoric acid in the insoluble portion was estimated by means of tin. The highly concentrated nitric acid solution was treated with fuming nitric acid, warmed, and digested with tin foil till the latter was fully oxidised. On filtration, the whole of the phosphoric acid remained in the precipitate. This precipitate was dissolved in concentrated potash solution, diluted, saturated with sulphuretted hydrogen, treated with very slight excess of acetic acid, and the tin sulphide filtered off by means of Bunsen's filter-pump, the use of which is absolutely necessary. The filtrate was concentrated, filtered from the tin sulphide which had precipitated during evaporation, and the phosphoric acid thrown down in the usual way. The filtrate from the tin oxide was treated with sulphuretted hydrogen to remove foreign metals, such as lead and copper, introduced by the tin, and the remaining metals determined in the usual manner.

The portion soluble in water was introduced into a weighed flask with a lateral tube by which aliquot parts of the weighed liquid could be removed for separate processes. The only one of these which presents any peculiarity is the process to which the platino-chloride of sodium was subjected. It was found impossible to remove all traces of magnesium from the alkaline chlorides by the use of ammonium carbonate and ammonia. The filtrate from the platino-chloride of potassium was therefore exposed to direct sunlight in a flask filled with hydrogen, the alcohol having been previously removed by evaporation. The platinum is quickly reduced, and the magnesium can then be estimated in the usual way.

We have no space for the details of the analyses which follow. Tables are given which show the percentage composition of the ash of the roots, stem, branches, and fruit, and the results are compared with the analyses of the ash of healthy plants made by Rowney and How and by Dr. Richardson. The most remarkable differences observed in the comparison are shown in the following table, showing the percentages of lime and phosphoric acid:—

	Lime.	Phosphoric Acid.
Root of diseased plant.. ..	61·82	1·57
Stem of ditto	70·67	2·66
Root of healthy plant	49·89	13·47
Stem of ditto	55·13	17·09

The phosphoric acid is thus shown to be in deficiency in the diseased plant, and the lime in excess. Similar differences cannot, however, be traced in the ash of the fruit.

Professor Williamson asked whether any fellows present had tried the use of tin in separating phosphoric acid. Considerable doubts had been entertained as to its value.

Mr. David Forbes had found the results obtained by the use of tin most unsatisfactory. Some oxides, especially that of iron, went down with the tin, and the whole of the phosphoric acid was not precipitated.

Professor Voelcker had also tried the tin process but could make nothing of. it. With reference to the question of the composition of the ashes of plants in disease, he remarked that we wanted data as to the composition of plants grown under different circumstances. The composition in health varied extremely with the nature of the soil, &c. Potatoes, for instance, exhibited the greatest variations of composition in different samples. In the determination of lime, it was not uncommon to find differences of from 10 to 18 per cent, and this in healthy plants. The speaker considered that too much reliance must not be placed on comparisons of this sort.

Dr. Attfield had made many analyses of the ashes of healthy and diseased potatoes and other members of the genus *Solanum*, and had been unable to observe any constant differences of composition.

Dr. Odling remarked that the differences in the percentages of lime recorded by Mr. Thorpe might be explained in the manner suggested by Professor Voelcker, but that the variations in phosphoric acid, supposing the analyses to be correct, were startling.

Professor Williamson: With different methods of analysis, chemists seem to get very different results. (Laughter.)

The Chairman enquired whether any of the Fellows had obtained good results with the molybdate process.

Mr. Forbes believed it to be the most accurate which had yet been suggested. It was necessary to take some precautions, in particular to allow the liquid to stand for a long time—25 to 30 hours—so as to become crystalline, before filtering it.

Professor Miller and Dr. Paul had both experienced great difficulty in washing the precipitate.

Professor Voelcker found that if silica was present in the solution, it went down with the molybdate, and was subsequently dissolved by the ammonia.

The Society then adjourned until Thursday, the 19th inst., when, in accordance with the President's summons, a general meeting will be held at eight o'clock.

Ketone of Formic Acid.—E. Mulder. Assuming the ketone of formic acid to be identical with formic aldehyd, this interesting compound may be expected to be formed by that reaction which is used for the preparation of ketones when applied to formic acid. On heating calcic formiate and condensing the products of distillation at a very low temperature, a liquid was obtained which had all the properties of Hofmann's formic aldehyd.—(*Zeitschr. Ch., N.F.* iv., 265).

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Estimation of Cobalt in Presence of Arsenic.—C. Winkler. The method for the volumetric determination of cobalt in presence of nickel, as proposed by the author some years ago (*Z. Anal. Chem.*, iii., 265. 420), was found to be inapplicable in cases where oxygen compounds of chlorine, sulphur, arsenic, and phosphorus were present. The method consisted in first mixing with the solution to be tested mercuric oxide, and then adding a standard solution of potassic permanganate. The injurious action of arsenic and phosphoric acid may, however, be easily avoided by precipitating them as arseniates and phosphates of iron, by adding a proportionate quantity of pure ferric chloride, an excess of which is removed from the solution by the subsequent addition of mercuric oxide. Sulphuric acid is removed by means of baric chloride. The solution does not require to be filtered before titration.—(*Z. Anal. Chem.*, vii., 47.)

Gilding Glass.—W. Wernicke. The following are the ingredients required:—1st. Solution of gold: pure gold (free from silver) is dissolved in aqua regia, the solution evaporated, and the residue taken up with water, so that 120 c.c. contain 1 gramme of gold. 2nd. Solution of sodic hydrate (which need not be absolutely pure) of 1·06 sp. gr. 3rd. Reducing liquid: 50 grammes sulphuric acid (monohydrate), 40 grammes alcohol, 35 grammes water, and 50 grammes powdered manganic peroxide, are distilled into 50 grammes water until the bulk of the latter is doubled—10 grammes cane sugar, inverted by dissolving in 70 c.c. water and boiling with 0·5 grammes nitric acid of sp. gr. 1·34. The distilled liquid, the inverted sugar, and 100 c.c. alcohol are mixed together, and the mixture diluted to 500 c.c.

In using these solutions 1 volume of the sodic hydrate solution is mixed with 4 volumes of the gold solution, and to this mixture is added from 1-35th to 1-30th volume of the reducing liquid. The object to be gilded is placed on the top of the solution, having the surface intended to be coated turned downwards. The temperature of the bath should be below 60° C. Glass surfaces must be cleaned with a solution of sodic hydrate and alcohol; cleaning with acids would prevent the film of gold from adhering firmly.—(*Pogg. Ann.*, cxxxiii., 183).

Chlorous Acid and Naphthalene.—Th. Hermann. On adding potassic chlorate to a mixture of moderately concentrated sulphuric acid and naphthalene, chlorous acid is generated, which, acting upon the naphthalene, causes the formation of various products of addition, substitution, and oxidation; of the last are phthalic acid and carbonic anhydride. As a product of addition an acid of the composition $C_{10}H_7ClO_5$, is obtained, the formation of which being represented by the equation—

$$C_{10}H_8 + (ClHO_2)_3 = C_{10}H_7ClO_5 + 2ClH + H_2O.$$

This acid is soluble in water, and on evaporating the solution separates in oily drops. It is gradually decomposed by water, more readily by baric hydrate, chlorine being substituted by hydroxyle, and a new dibasic acid formed. The latter acid, which is amorphous like the former, is readily soluble in water, reduces an ammoniacal silver solution, and forms a soluble precipitate with plumbic acetate.

Further products of the reaction are dichlornaphthalene, which is obtained in large quantities, and a sulphoacid which is obtained as a potassic salt of the composition $C_{10}H_4KClSO_6$. This salt crystallises in small brown crystals which dissolve in water, producing a dark red solution. When subjected to dry distillation naphthtoquinone, besides other compounds is formed.—(*Sitzungsb. d. Ges. z. Bef. d. ges. Naturw. z.*, Marburg, 1868, 48).

Benzoyle-Paraphenolsulphuric Acid.—A. Engelhard and P. Latschinow. The action of sulphuric anhydride

upon phenylic benzoate gives rise to the formation of various compounds, according to the conditions of the experiment. At 0° C., benzoyleparaphenolsulphuric acid is principally formed—

$$C_6H_5O(C_7H_5O) + SO_3 = C_6H_4(HSO_3)O(C_7H_5O).$$

If the reaction is allowed to continue, another acid, of the composition $C_6H_2(HSO_3)_3O(C_7H_5O)$,—or, perhaps, $C_6H_3(HSO_3)_2O[C_7H_4(HSO_3)O]$, *i.e.* benzoyle-sulphophenoldisulphuric acid—makes its appearance.

At ordinary temperatures and with an excess of sulphuric anhydride, an energetic reaction takes place, accompanied by a rise of temperature and benzosulphuric together with phenoldisulphuric acid are obtained—
$C_6H_5O(C_7H_5O) + 3SO_3 = C_6H_5O.(C_7H_5O)3SO_3$, or more probably $= C_6H_4(HSO_3)_2O + C_7H_4(SO_3)O$, *i.e.*, phenoldisulphuric acid, and the anhydride of benzosulphuric acid. Benzoyle-paraphenolsulphuric acid is easily separated from those accompanying it by being converted into the baric salt, which is almost insoluble in water, while the corresponding salts of the other acids are readily soluble.

Another method for the preparation of this acid consists in acting upon paraphenolsulphuric acid with chlorbenzoyle—

$$C_6H_4(HSO_3)OH + H_2O + 2C_7H_5OCl =$$
$$= 2HCl + C_7H_6O_2 + C_6H_4(HSO_3)O(C_7H_5O).$$

The reaction which sets in at once has to be assisted by gently heating the mixture; the acid is then extracted with cold water.

The authors confirm Kekulé's statement as to the existence of two isomeric sulphoacids of phenol. The potassic salts of para- and meta-phenolsulphuric acid are differently acted upon by chlorbenzoyle—

Para-acid.

$$C_6H_4(KSO_3)OH + C_7H_5OCl =$$
$$= HCl + C_6H_4(KSO_3)O(C_7H_5O).$$

Meta-acid.

$$C_6H_5O(KSO_3) + C_7H_5OCl = KCl + C_6H_5O.C_7H_5O.OS_3.$$

—(*Zeitschr. Ch., N.F.*, iv., 75).

NOTICES OF BOOKS.

Braithwaite's Retrospect of Medicine. Vol. 57. Simpkin and Marshall.

Like the previous volumes this fifty-seventh half-yearly retrospect of medicine is invaluable to the busy practitioner. As we write the word "practitioner," we are struck that a learned profession should endure a designation so uncouth and ear-offending. If one, never having heard of the ambiguous title "general practitioner" as applied to a doctor practising both medicine and surgery, were asked the probable application of this equivocal designation, he would inevitably connect it with a breaker of the law not very particular in his predatory range from handkerchiefs to housebreaking. Besides the titles of doctor or physician and surgeon, a middle term is required to denote the bulk of the medical profession, who combine the practice of both medicine and surgery. If no single word is available, surely physician-surgeon or surgeon-physician would more fitly designate one who practises both branches of his profession than the nondescript, ill-sounding title, "general practitioner."

Throughout this volume, as in the more recent volumes, there are manifold indications of the deepening conviction that zymotic diseases are caused by the action of various kinds of infusoria, and that ultimately some chemical means will be discovered capable of destroying them in the human economy. Of considerable interest to the pharmaceutical chemist are two papers by Dr. Sansom, who strives to show with a noteworthy array of facts, which at a future time he promises to strengthen, that a combination of sulphites with carbolic acid has proved remarkably efficacious in the treatment of cholera, small-pox, scarlatina, &c. He has succeeded in making compound salts of sulphuric and carbolic acids with potash, ammonia, soda, and magnesia. Who can gainsay the reasonable expectation that chemistry will one day yield an antidote as potent against zymotic diseases as quinine is against ague?

CORRESPONDENCE.

OZONE.

To the Editor of the Chemical News.

Sir,—In reply to your correspondent who has kindly noticed my few remarks on ozone observations (Chemical News, vol. xviii., p. 202), I beg to enclose the following rules:—

1. Use Schönbein's test-papers, as sold by Casella.
2. Expose them in the small-sized ozone cage (Sir James Clarke's) as made by Casella.
3. Give exact particulars as to the *height*, *position*, and *surroundings* of the cage.
4. Change the test-papers every twelve hours—at 9 a.m. and 9 p.m.
5. Use Schönbein's scale; at the same time note very carefully the different shades and modes of distribution of the colour over the test-paper (as, for instance, whether equally distributed, or in specks or spots), with the view to the formation of a more perfect scale.

Should your correspondent succeed in organising a club such as he proposes, I shall be most happy to contribute, so far as I am able, observations on ozone.—I am, &c.,

R. C. C. Lippincott, jun., F.M.S.

Over Court, near Bristol,
Nov. 5, 1868.

CHEMICAL LABORATORIES.

To the Editor of the Chemical News.

Sir,—It was with great pleasure that I read the article upon chemical laboratories which appeared in your last impression. Something of the kind has been long required to show how sadly we are in want of more chemical laboratories, and how altogether inadequate to our wants are the few poor and ill-furnished ones which we possess.

I trust that the writer will allow me to correct one statement of his which is likely to leave an erroneous impression upon the minds of many, viz., the following:—"The School of Mines had a very limited idea of its duties as regards chemistry when it gave only a corner for its exercise." Now this "small room in a corner," as he very aptly and strikingly describes it, is now no longer the chemical laboratory, although it may have been at a former time, but is used as the metallurgical laboratory. The reader may judge for himself whether the term "small room" is applicable or not when he is told that it contains benches for about eight students, and that more could not possibly be squeezed in.

At the present time there are about twelve gentlemen working, or rather endeavouring to work, in this place, besides others who are waiting to do so, so that the authorities cannot say more space is not required.

On the other hand, the extent of the chemical laboratories is somewhat greater, comprising, in fact, the Royal College of Chemistry, which affords accommodation for nearly 50 students. We thus see that the Royal School of Mines pays rather more attention to chemistry than one would suppose from the reference made to it in the paper to which allusion has already been made, although even that attention is nothing like sufficient.

Apologising for taking up so much valuable space, I am, &c.,

A. L.

ESTIMATION OF FREE HYDROCHLORIC ACID.

To the Editor of the Chemical News.

Sir,—In determining the amount of escape of hydrochloric acid in different alkali works, I frequently find it necessary to recognise and estimate the amount of this acid in a mixture which may contain sulphuric acid, sulphates, hydrochloric acid, and chlorides.

As I have never found a satisfactory plan of doing this described in any of the books I have consulted, I give you the method I adopt, hoping it may be useful to other chemists. I first obtain an aqueous solution of the substance to be examined, if gas from a chimney or flue, by drawing through water by means of an aspirator; if a solid, by lixiviation with water. To this solution I add precipitated carbonate of baryta in a moist state, digest for a short time, boil to expel carbonic acid, and thus precipitate any carbonate of baryta held in solution, and filter.

The whole of the hydrochloric acid having by this process been converted into chloride of barium, from the amount of baryta in the filtrate, the quantity of free hydrochloric acid in the original substance may be easily calculated.—I am, &c.,

John T. Hobson,
Inspector of Alkali Works, Middle District.

Leigh, November 7, 1868.

PERIDOTE METEORS.

To the Editor of the Chemical News.

Sir,—In your valuable journal of Nov. 6 you give the results of an analysis recently made by my friend, Professor Pisani, of the meteoric stone that fell on the 11th of July, 1868, at Ornans (Doubs), which analysis shows as much as 75 per cent of peridotic silicate. M. Pisani has remarked on this occasion that the proportion of peridote in this meteorite is much larger than in any other known.

I should be glad if you would allow me to observe that in my work "Meteors, Aërolites, and Falling Stars," published in London in 1867, which contains all the analyses of meteoric stones made up to that date, I have given (p. 112 *et seq.*) a complete account of the fall, and two analyses of the remarkable meteorite which fell on the 3rd of October, 1815, at Chassigny, near Langres. This meteorite consists almost entirely of peridotic material. There is a small fragment of it in the collection of the British Museum. It does not appear to contain any iron or nickel in the metallic state, but to contain no less than about 90 per cent of ferruginous olivine, hence it belongs to the third section of my classification, viz., meteorites containing little or no metal.

This complete absence of metallic ingredients may perhaps account for the curious fact that when this stone fell no globe of fire was seen. It was observed to fall (at half-past eight in the morning), after a series of detonations, from a grey cloud above the north-east horizon, and penetrated about two feet deep into the soil of a vineyard; a thick smoke issuing from the ground indicated the spot where it fell.—I am, &c.,

T. L. Phipson, PhD., F.C.S.

The Cedars, Putney, S.W., 7th Nov., 1868.

MISCELLANEOUS.

Condy's Fluid.—The judges of the Havre Exhibition have awarded three prizes to Mr. H. Bollmann Condy for his Patent Fluids, viz., the silver medal in Class II., the silver medal, and special vote of approbation at the Naval Medical Congress.

Secure Cement for Envelopes.—The editor of the *Practical Mechanics' Journal* says that the thick glutinous juice which is found in considerable quantities in the interior folds of the leaves of the New Zealand flax (*Phormium tenax*), and which is, in fact, a sort of hemp in natural solution, possesses the properties desired. While liquid it can be used as common gum; but once dry, no ordinary solvent has any action upon it. This natural product might be collected, and probably without prohibitory expense and in sufficient abundance, as the *Phormium* is a New Zealand weed, covering whole square miles. It is still open to experiment for the colonists there to add this to their produce, and it is for some of our Waterlows or Spottiswoodes to initiate it, by getting to England such a first supply of the juice as would enable our chemists to examine its precise nature, and to assign the conditions for, and limitations to, its use for envelopes. It is said that silk dissolved in chloride of zinc affords another sort of liquid cement presenting some, at least, of the characters here needed; but it has others which are objectionable, as tending to destroy in time the paper. Again, it is stated that a solution of pure woody fibre in ammonio-chloride of copper embraces the requisite properties. Dr. Scoffern has, the writer believes, experimented a good deal upon this and other uses for this very singular compound, but he is not aware how far it has been found suited to closing envelopes. He does not anticipate well of it in some respects, and those the same as render the silk solution objectionable.

Lamentable Accident.—On Wednesday, October 28th, a most deplorable accident occurred in an extensive chemical works at Runcorn, Cheshire. A young gentleman, William Henry Exall, B.Sc., B.A. (London), who occupied the situation of analytical chemist there, was going through the works between 6 and 7 p.m., and, in the obscurity of the evening, actually walked into a vat, sunk about 3 feet in the ground, and containing a hot acid solution of chloride of copper. He sank up to the neck, but managing by some means to get out himself, he walked to another part of the works, where he obtained assistance, was borne to his lodgings on a stretcher, and, after thirty-six hours of great suffering, breathed his last at 6 a.m. on Friday morning, October 30th, aged twenty-two years. He was a young man with acquisition and talent of the highest order, and combined with an unaffected simplicity of manner and noble hearted generosity of sentiment which were alone sufficient to win him the admiration and affection of all who knew him. He lived a true christian. A few weeks before his death he had commenced reading for the degree of Doctor of Science. The writer, whose successor he was at the above-mentioned works, mourns in his loss that of a dear and much-valued friend.—Watson Smith, F.C.S.

The New High School and Laboratories of Paris.—The provisions of the recent decrees for the establishment of a practical high school and laboratories of study and research, already noticed in the *Journal of the Society of Arts*, are being carried into effect on a grand scale, and the demands for admission exceed all expectation. As regards the school, there are already more than 150 applications, viz.:—Fifteen for the section of mathematics; fifty-one for that of physics and chemistry; forty-seven for natural history and physiology; and forty-four for the section of history and philology. Amongst the candidates inscribed are several young men who have taken the degree of *agrégé*, or doctor, and others who quit the career already entered upon for the new school; many of the applicants are foreigners. The studies will commence in all the four sections at the usual scholastic period—viz., the middle of November. Some of the laboratories will be opened about the same time. At the Sorbonne, the laboratories of physics, botany, physiology, and geology, to which MM. Desains, Duchartre, Claude Bernard, and Hébert have been appointed, will shortly be ready, and a large chemical laboratory, over which MM. Pasteur and Sainte Claire Deville will preside, is now being erected by the side of the physical laboratory built last year and directed by M. Jamin. At the College of France, and at the Ecole Normale, the chemical laboratories of MM. Balard and Berthelot will be ready in good time; and those of M. Claude Bernard for physiology, and M. Pasteur for physiological chemistry, somewhat later. At the museum of the Jardin des Plantes, the laboratories of Milne Edwards for zoology, and of M. Decaisne for vegetable culture and physiology, are ready. New and larger establishments are being arranged for botany, chemistry, and comparative physiology. The provinces express the desire that their laboratories should be considered as annexes of the new school; several towns propose to develop their means of superior education; and the Conseil-Général of Calvados has taken the lead by voting a grant of money in aid of the study of agricultural chemistry in the laboratory of research, instituted at the Faculty of Sciences of Caen. The council of the new high school is convened for the third of November, and the following are the names of the members appointed, in addition to those mentioned in a former notice, who have seats in the council on account of their official positions:—In the section of mathematics, MM. Bertrand, Chasles, Delaunay, and Serret, members of the Institute of France; M. Puiseux, professor in the Faculty of Sciences of Paris. Section of physics and chemistry, MM. Balard, Frémy, and Wurtz, members of the Institute; MM. Desain and Jamin, professors in the Faculty of Sciences. Natural sciences: MM. Claude Bernard, Brongniart, Decaisne, and Milne Edwards, members of the Institute; M. Hébert, professor in the Faculty of Sciences. Historic and philological sciences: MM. Maury, L. Rénier, de Rougé, and Waddington, members of the Institute; M. Bréal, professor in the College of France. The list of the laboratories given above shows the extent to which this new system of superior scientific education is to be carried, and the names of the professors and members of the governing council afford a guarantee of the quality of the instruction to be afforded. The scheme is certainly the most important and the most extensive of all those which have yet been put forward for the dissemination of high scientific knowledge.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Comptes Rendus,
August 17, 1868.

E. de Beaumont, "Note on H. E. Roscoe's Memoir on Vanadium." J. Nickles "On Manganese-manganic Fluoride." A. Renard, "On the Volumetric Estimation of Zinc." T. de Purgold, "On Chlorosulphuric Ether." H. Schiff, "On Condensed Ureas. (Second Memoir). E. Paterno, "On Bichlorinated Aldehyde." "On the Action of Zinc-Ethyl on Bichlorinated Acetal."

August 24, 1868.

B. Savy, "Memoir on the Density and Saltness of Sea Water in the Atlantic, and on the currents of that Ocean." Salet, "On the Colouration of Peroxide of Nitrogen."

Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften zu Wien. (*Mathematisch-Naturwissenschaftliche Classe.*) Division 2.
March, 1868.

W. F. Gintl, "Contributions to the Knowledge of the Combinations of Double Metallic Cyanides with Ammonia. G. Tschermak, "An Attempt to Develop the Equation expressing the Chemical Change which takes place in the Formation of Minerals."

Poggendorff's *Annalen der Physik*.
No. 6, 1868.

A. Töpler, "Optical Studies by the Author's New Method: On some Phenomena of the Electric Spark." G. Magnus, "On the Diathermancy of Sylvine."

No. 7, 1868.

" C. Rammelsberg, " On Periodic Acid and its Salts."

Annalen der Chemie und Pharmacie.
September, 1868.

H. Hubner and R. Biedermann, "On the Preparation of Amidobenzoic Acid from Parachlorobenzoic Acid and Chloralylic Acid." W. Luddecke, "On some Combination and Decomposition Products of Triglycolamidic Acid." R. Fittig and E. von Furtenbach, "Researches on Mesitylene." (Fourth Memoir). "On the Oxidation Products of Mesitylene." W. Weith, "On the Compounds of Nitroprusside." F. Beilstein and A. Kuhlberg, "On Substituted Alcohols and Aldehydes: Paranitrobenzyl Alcohol. Parachlorobenzyl Alcohol. Paradichlorobenzyl Alcohol. Paradinitrobenzyl Alcohol. Parachlorobenzoic Aldehyde." E. Neuhof, "On some Derivatives of Parachlorobenzyl Alcohol." C. Friedel and A. Ladenburg, "On the Preparation and the Reactions of a Silicium Oxychloride. J. von Liebig, "On the Preparation of Alloxan."

Bulletin de la Société Industrielle de Mulhouse.
June, 1868. Supplement.

A. Scheurer-Kestner and C. Meunier, "Analysis of the Gaseous Products of the Combustion of Coal from Saarbrück." A. Rosenstiehl, "Researches on T. Coupier's Method of Manufacturing Liquid Toluidine and Commercial Aniline."

July, 1868.

A. Violand and Co., "Note on the Author's Establishment for Drying and Preparing Herbs employed in Medicine at Colmar." Kuhlmann, "Report on A. Violand and Co's. Establishment for Drying and Preparing Herbs employed in Medicine at Colmar." J. Gerber-Keller, "Report on C. Courtois and Co's. Manufacture of Nitrobenzine and Aniline at Mulhouse." Marnas, "A New Aniline Dye." Chevreux, "A proposed Method of Extracting a Colouring Matter from the Cockchafer." A. Scheurer-Kestner, "Memoir on the Combustion of Coal." Rosenstiehl, "Report on T. Coupier's Method of Manufacturing Liquid Toluidine and Commercial Aniline."

NOTES AND QUERIES.

Rock Phosphates.—Can any of your readers inform me if these can be had, and the price in quantity?—L.

Acetic Acid.—Which is the best way to estimate acetic acid in commercial acetate of lime, which contains a large quantity of tarry compounds of lime?—G. N.

Reichenbach's Researches in Magnetism.—Will you kindly allow me to ask through the medium of your Notes and Queries where I can obtain a copy of "Reichenbach's Researches in Magnetism, Part 3rd," translated by Dr. Gregory. I have with much difficulty procured Parts 1st and 2nd, and am told that Part 3rd must be out of print.—A Subscriber.

Coal Tar Products.—On mounting crystals of picric acid (purified until white) for the microscope, I find that the crystals form in clusters of needles branching from a common centre, forming minute trees and shrubbery, both singly and in clusters; these crystals are so minute that their structure is not distinguishable by the unassisted eye. Pure carbolic acid in crystals if warmed, and when melted poured into a bottle and shaken up so as to smear the sides, will form the same style of crystal, only that with the carbolic acid the crystals are from a half to two and a half inches long from the base to the tips of the branches. Picrate of potash, when exploded, gave a very distinct smell of bitter almonds. Is this the ordinary result of its decomposition, or is it due to impurities?—New Berne.

TO CORRESPONDENTS.

A New Subscriber.—There is no special book on the subject.

E. A. P.—Our correspondent has read the passage in an entirely different sense from the one intended. We quite agree that the subject is one which need not be discussed in these columns.

S. Gibbons.—1. The report is very valuable, and shall receive early notice. 2. The numbers enquired for are out of print. Your only chance is to get a bound volume, which may occasionally be picked up second-hand—at a large increase on the original price. 3. We will make special enquiries about the books you ordered. The other communications were received with thanks.

A Young Chemist.—The special details in preparing nitrate of lead in crystals can only be found out by experience. No book would enter into such minutiæ as you require.

Communications have been received from Professor Heaton; G. Wigner; Dr. T. L. Phipson; W. Little; Sydney Gibbons, Melbourne (with enclosure); E. A. Parnell; A. Liversidge; J. Goulding; W. Fergusson (with enclosure); Dr. R. Angus Smith, F.R.S.; S. Burke; H. Williams (with enclosure); Dr. Röhrig; J. Spiller (with enclosure); Brooke, Simpson, and Spiller; Bollmann Condy and Co.; Watson Smith, F.C.S.; J. S. Smith (with enclosure); Rev. O. Fisher (with enclosure); J. Mackie; J. Storey and Co.; J. C. Lee; G. F. Rodwell; H. Hopkins; and A. C. Hadland and Co.

BOOKS RECEIVED.

The A B C Sewage Process; being a Report of the Experiments hitherto made at Leicester, Tottenham, and Leamington, on the Purification and Utilisation of Sewage.

The Elements of Heat and of Non-Metallic Chemistry. By Frederick Guthrie, B.A., Ph.D., F.R.S.E., F.C.S. London: John Van Voorst.

A Manual of Elementary Chemistry, Theoretical and Practical. By George Fownes, F.R.S. Tenth Edition. London: Churchill and Sons.

THE CHEMICAL NEWS.

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A GLANCE AT GERMAN TEACHING.

It is possible to exaggerate the value of laboratories, but it is also clear that fine work cannot be obtained by coarse machinery. A friend tells us that the finest—*i.e.*, most practical—laboratory he ever saw was in a kind of shed built by Dr. Boswell Reid, in Edinburgh, but we know how the Scots admire their own. To us it seemed that it was Liebig's new laboratory that took us fairly out of the habits of the alchemistic age. Even after it was built, Heidelberg had its chemist, a man of the highest celebrity in his department, working in a spot so furnished with black furnaces, heavy hoods, crucibles, and other fire machinery that students from the newer building scarcely could imagine what work could be there done; and if they had read poetry and romance it was, at first sight, Faust, Auerbach's Keller, and necromancy that came more readily into their minds than chemical apparatus. But if they approached the study, these distant times soon disappeared. The master sat in a clear and bright well-ordered apartment; ask him a question on any subject connected with chemistry, and before answering he goes to one of the numerous pigeon-holes on the wall and takes out loose leaves, each containing extracts from the latest publications. He himself sat as judge on all that the chemical world studied. Gmelin was a fine type of German diligence in the study. Liebig showed a rarer set of qualities; he wrote, he worked, and he stimulated. With Gmelin in the hands of every student, and the example of Liebig driving them forward, the later impulses to study chemistry began, and have continued without ceasing. This is said in full appreciation of the brilliant chemists which France then had, and we may say has always had since the science began, as well as of the fact that Berzelius was alive. But there was a force at that time, as there is still, peculiarly advancing in German action as well as thought. And even when her ideas did not lead, there was a vigour in her system of education which turned all eyes towards her. We may therefore be excused for taking her as our chief standard of comparison for our present purpose. On hastily reviewing the growth of laboratories of late, it seemed as if England were always stepping forward, although keeping behind Germany, and this even when we did not take the numbers into consideration. Few men have visited all the universities of Germany, and none, probably, have seen all her higher schools where science is taught; but many persons have seen several of these, and none have seen them without wonder. The political division of Germany has produced many peculiarities, amongst others the many centres of education. The cause lay partly in the extent of the country, united with the slow and difficult travelling. The desire for political union, the new impetus to the study of science, and the beginning of railways seem to have acted on the nation simultaneously, and there arose the love of wealth and a determination to do at least as much as England had done.

The wealth of Germany thirty years ago was very slightly developed; even twenty years ago the people were not out of the traditions of the middle ages in great towns, and even now in small towns one may almost live as in the times of Luther. But within ten years there has been a growth of manufacturing industry sufficient to have altered the features of many places, and the natives do not require to visit Birmingham for chimneys, or even the black country for dreariness. The wealth of the country is wonderfully increased, and liberty, political and personal, has followed education. Some politicians will reverse the order—and such may have been to some extent the case in our country; but it is also very clear that without education no liberty can be complete.

The change has been preparing for a long time. The preparation has been made by attending most minutely to all details of management. The government has been like a kind but strong-willed father, that was determined to bring up every child well, but was ready also to lay his hand heavy upon him if he diverged from the prescribed route. The consequence was a certain sameness and littleness if we looked at few parts, but the extent was great. The mode of education suited the national mind, which was always attentive to small objects, even when attempting great. We find in their old books as much formality as in the present bureaus of the officials.

One sees it at the first moment of entering a hotel, where literal exactness is visible, and you are written down. If you enter a university you must undergo still more; you must have your certificate of birth and of confirmation, sometimes your certificate of vaccination and your passport; and the German who leaves his home goes carefully preserving them through all the world, as if by a kind of witchcraft he died with his description. The amount of writing everywhere done is strange to behold. If we enter still further and see his inner thoughts as displayed in his books, we find an attention to detail that surpasses the comprehension of most of us. In describing a scene, we can imagine him speaking of each object separately, if time would permit; but he is obliged to be content with every species and variety, giving a fullness to his work which makes it a mine of wealth to those who search for detail. How far can we imitate him? We shall never do exactly as he does; but for a nation like ourselves, rather apt to rush to ends without making a beginning, an imitation to a large extent would be a fine training for our youths. Germany has been a slave to its details—why shall we be the same? If it has been a slave it has been for the good of mankind. It is the intellectual miser among nations—and what a glorious run we can have amongst their wealth—which they have supplied in amounts greater than we have been able to sqander.

Let us try another illustration. The German intellect is farthest removed from the Irish—the first is conscious of every step in reasoning; the second leaps over a dozen, and often misses its way. The power of leaping and flying are glorious powers. One may go direct to the top of the mountain without touching the sloughs below. The German crawls through the sloughs, but he leaves behind him a good substantial road, which only requires to be illuminated to become the much-desired object—a king's highway to learning. It would be exceedingly pleasant to follow this out into the history of science, and to observe what flashes of light have gone from various nations; but it would equally surprise us to see that the German will not be behind even if he have nothing to collect for his fire but brushwood; he will heap it up until it becomes grand by quantity.

And how shall we apply these remarks to ourselves? If we differ from the Germans, why should we imitate their modes of education? There is a mode of training every animal, but not one mode for all. Some will say, then, if the German is so fond of details, let him be fed upon them; if we like conclusions, let us have them, and waste no time. But this conclusion is too hasty. It is the weakness of the German to be so fond of detail, and it is his strength to be so well acquainted with detail; it is our weakness to dislike it, and it is our strength to overleap it. Among these apparent contradictions it seems hard to steer our course, but we may begin thus:—A trained man can be depended upon so far; an untrained may do better, if he has genius; and who can tell what he may have? We cannot train men to be marvels, and if they were they must still submit to some extent, and the only resource left to us is to yield to the influence of plodding in education, caring, however, to observe if any of the young thinking machines that we are polishing shew any peculiar movement which shall be indicative of progress beyond the teacher's intention. These spasmodic wilful movements may take place amongst our youths more rapidly than among the Germans; but it no less becomes us to look for fundamental training in the direction where it has been most successful. If our youth become weary sooner, it is well that we should seize on them as early as possible. It is from our Teuton friends that we have received models of careful teaching from their kindergarten upwards. These infant schools were a step beyond ours—introducing practical lessons; their laboratories are the same idea carried out. Let a man touch and handle if he will learn. Let our youth be taught natural laws by seeing them in action, not as abstractions only.

The first thing that will occur to many people to say is —"This is exactly the method of the practical English nation: the opposite has been the custom of the dreamy Germans." True we sent boys into practical life to pick up principles at random; and those who thought enough made systems for themselves. This apprenticeship method was good when principles were on the surface; but when they are so deeply sunk that generations have been required to find them, and when the phenomena themselves are not superficial, the method falls to the ground. No man can learn his duties in a chemical work by apprenticeship, or by the imitation of the actions of others.

The rapid development of the teaching of physical sciences in Germany was the result of previous training, and the rapid development of manufactures followed immediately.

But we must take the privilege of Englishmen, and rush through intermediate stages to a conclusion. That seems to be that in Germany the army of labour is organised as carefully as that for fighting. The unanimity is complete, and the determination to invade our markets is strong. Every chemical work has at least one trained chemist, and the training is careful. With us it is frequently considered needless to have one for large works, as they can go by themselves, and small works cannot afford one. We know very well that this is not universal, but some of the exceptions are more apparent than real, and at any rate we shall defer speaking on that point.

SPECTRUM OBSERVATIONS OF THE SUN.

In continuation of our account last week we have to report further discoveries on this subject. The Rev. Father Secchi, writing to the Abbé Moigno from Rome, says:—

"Two words, in haste, to tell you that I have been able to satisfy myself of the reality of the discovery of Messrs. Janssen and Lockyer, on the luminous rays of the solar protuberances, in full sun this morning. Yesterday I received your copy of *Mondes*, and I set to work this morning. As if by magic, after having directed the spectroscope towards the apparent upper edge of the sun, I hit upon a protuberance perfectly detached from the sun's border.

"The line, C, shone in the middle of the spectrum, and so as to render mistake impossible, it was prolonged above and below by the continuation of the black line.

"At one point about 45° from the apparent northern edge towards the apparent west, I found a second brilliant ray, C, which encroached on the edge of the sun. At about 160° I found a twinkling protuberance, that is to say one which was visible at intervals, and then disappeared. Not trusting to my own eyes, I called my assistants, and all, to the number of four, saw these curious phenomena.

"Returning to the first protuberance, I distinguished the ray, F, but not so long; besides, I saw a brilliant ray beyond D, on the side of the blue, shine with great brilliancy, similar to that which separates the two widest rays of magnesium.

"A very apparant fact, and one which shows the abundant presence of hydrogen, even where it does not shine as a protuberance, is that the ray, C, vanishes almost everywhere around the sun at the same time that the ray F becomes much enfeebled. It appears that in these regions the direct light has no other effect than that of paralysing the absorption of the rest of the envelope. What consequences may we not expect to result from this discovery? I will leave till another time the studies which I have made to facilitate these observations. I may say that I have seen all this by reducing the aperture of my large glass to 8 centimetres; I feared to endanger my sight by employing a larger aperture. The spectroscope is one of Hofmann's, with two heavy flint prisms."

Mr. Lockyer has made some additional observations, which are briefly described in the following extract from a letter which he has written to Dr. Warren De La Rue:—

"Since my last communication the instrument which I used has been completed; when I commenced, it was in a very imperfect state. I have been able to recognise that the protuberances are simply local accumulations of a gaseous envelope which completely surrounds the sun, for in all parts of the circumference of the star I perceive the characteristic spectrum of the protuberances.

"After all there is something important in my communication of 1866. It is a pity that in the search after truth we depend so much on the minute adjustment of our instruments.

"The thickness of the new envelope, which I hope you will publish on my behalf, is nearly 5,000 miles; it is marvellously regular in its contour. At the pole, as at the equator of the sun, the spectroscope reveals its existence at a sensibly equal distance from the disc of the star.

"In a communication to the Royal Society I shall point out how we may determine the temperature of this new envelope."

PHOSPHATES IN AGRICULTURE.

Much attention has been given of late in France to the treatment of coprolites and other bodies containing phosphates applicable as manures; and an agricultural writer, M. Adolphe Bobierre, has given, in the *Journal de l'Agriculture*, of Paris, an account of the methods in action, and experiments in connection with this important question.

"Guanos from tropical regions," says M. Bobierre, "bone ashes from the pampas of Central America, phosphorites and apatites from Spain and Portugal, coprolites and nodules from the early limestone formation, the refuse of sugar-houses and refineries, gelatine and button manufactories, everything in fact which contains phosphoric acid in any quantity, is now the object of serious and generally profitable application. Guano is obtained from the giddy heights of the mountain peaks in sight of the coast of Bolivia, while in the Ardennes it is found worth while to remove sixty or more metres of argillaceous earth to obtain a ton of phosphated nodules, which, when washed and pulverised, rival bone-black.

The writer recognises the great activity of English chemists and agriculturists with respect to phosphates and the production of superphosphates, and the immense services which they have rendered; but adds that the manufacture of superphosphates cannot be said to be perfect so long as the sulphuric acid is lost.

With respect to what has been done in France, M. Bobierre gives some interesting examples. The nodules of phosphate of lime have been largely employed in Brittany, in the cultivation of the Landes, in the place of bone-black, which has been used largely for thirty or forty years; this has created a very important employment, and we are told that many of the dealers in manure have entirely given up the sale of bone-black for that of pulverised fossil phosphates. Attempts have been made to separate the phosphates from the 30 per cent or more of siliceous matter, with which they are associated, and also, on the other hand, to produce mixed manures, in which the activity of the phosphoric acid should be brought out in the most effective manner; these desiderata have been realised with considerable success. One process is to treat the rough phosphates with chlorhydric acid, and to recover the acid by evaporation. Another process mentioned is to convert the nodules into metallic phosphites by calcination in a blast furnace, in contact with iron ore, and then to transform the metallic phosphites into alkaline phosphates by the action of chloride of sodium at a high temperature. A third method is to attack the fossil phosphates by means of chloride of manganese with an excess of acid, obtained from the manufactories of chlorides for bleaching and other purposes; and, lastly, the fossils are sometimes simply calcined with gas tar or other similar substances.

The writer says that the results of the above methods and experiments have confirmed him in a previously expressed opinion, that if the nodules be reduced to a powder, and the powder exposed to the action of the air, and applied to soil requiring the application of phosphoric acid the fossil phosphates are perfectly assimilated; and, further, that a mixture of fossil phosphates with ordinary manure yields the most admirable results, even in the case of old cultivated lands. "Let farmers only adopt the habit of throwing fossil phosphates under the animals," says the writer; "nothing more is required."

M. Bobierre seems to consider the treatment of nodules by means of acids as scarcely called for, but recommends this process strongly in the case of phosphorites, apatites, and certain phosphatic guanos found almost in a vitrified condition.

With respect to France, the writer observes that within a short distance of the coasts of Spain and Portugal, where the tribasic phosphates, containing 70 to 90 per cent of phosphate, may be obtained at the rate of 2s. 6d. to 3s. 4d. per cwt., enormous quantities of hydrochloric acid are wasted, and worse than wasted, by being allowed to vitiate the air; the town of Marseilles, which converts large quantities of sea-salt into sulphate of soda, is destined to waste annually 50,000,000 of pounds of hydrochloric acid, which could, with very little trouble, be made to dissolve the natural phosphates.

In connection with the above may be mentioned a communication made by MM. Dusart and Pelouze to the Academy of Sciences. One of these gentlemen, in a work entitled "Researches on the Assimilation of Phosphate of Lime," showed that, when acted upon by the gastric juice and very diluted lactic acid, phosphate of lime underwent partial decomposition, yielding a mixture of lactate and acid phosphate of lime; this led to experiments on the action of carbonic acid on phosphate of lime, with the view to throw some light on the obscure subject of the assimilation of phosphate of lime by plants. In 1864, M. Dumas noticed that carbonic acid was a solvent for phosphate of lime, by the effect of seltzer water, in softening ivory and abstracting all the calcareous phosphate therefrom. Other chemists have regarded this action as merely a solution of the salt by the carbonic acid, but MM. Dusart and Pelouze are of opinion that the action referred to is of a more complicated character, and that the acid absorbed gives birth to new products.

These gentlemen treated gelatinous phosphate of lime with water, saturated with carbonic acid, and found that after some time the acid had partly disappeared, and the phosphate itself had notably diminished; the transparent liquid obtained by filtration deposits by heat a crystalline precipitate, composed of phosphate and carbonate of lime. A series of nice experiments is then detailed to prove that bibasic phosphate of lime is produced, either by the action of carbonic acid on tribasic phosphate of lime, or by that of acid phosphate of lime on the carbonate. On this principle, say MM. Dusart and Pelouze, we have been able to produce it by the following economic practical method, in such a state of purity that, compared with superphosphate, it contains double the active power in an equal volume. The matter to be dealt with—natural phosphates, coprolites, bones or animal charcoal—are placed in wooden vats lined with lead, communicating with each other and covered with a mixture of water and acid; any acid will effect the transformation, but we prefer hydrochloric acid or the weak nitric acid, which is wasted in so many works. When the acid has macerated in one vat, we remove it into a second, and if necessary a third, and the clear liquor is finally treated with pulverised carbonate of lime; effervescence is produced, carbonic acid is thrown off, and a precipitate of white crystalline bibasic phosphate of lime is thrown down. When sufficient carbonate is used the liquor is deprived of all the phosphate that it contains, and the precipitate is easily dried and washed.

These facts enable the chemists in question to form the following hypothesis concerning the manner in which nature enables plants to take up phosphates. It is evidently in the soluble form that the plant uses them for its nutrition; the common phosphate of lime, completely insoluble in water, should therefore be rendered soluble. Carbonic acid dissolved in water performs this first transformation in the same way that the stomach of an animal renders it soluble, by converting it into acid phosphate and lactate of lime. The enormous quantity of superphosphate of lime employed in England, a practice now adopted in France, is quoted in support of the above theory. The superphosphate, which, according to these gentlemen, is only an impure acid phosphate of lime, when introduced into the soil attacks the carbonate of lime, under the influence of humidity, and is thus transformed into a bibasic phosphate. As it is impossible to imagine that any substance can be entirely absorbed by plants during the first few days of its being spread upon the ground, if the superphosphate do not undergo this transformation, which diminishes their too great solubility, they would certainly be carried down to the sub-soil by the first heavy rain, and part of their value thus lost. The facility with which bibasic phosphate of lime can be produced in a state of great purity renders it a promising substitute for common phosphate, and even for superphosphate, which is always mixed with a large proportion of other matters, which have no value as manure, and of which the cost of carriage is, therefore, at any rate, a loss to the farmer.—*Journal of the Society of Arts.*

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Continued from page 200.)

Constructions of Dietaries: Preparation and Culinary Treatment of Foods.

Treatment of Foods.—In the treatment of vegetable foods it is important to remember that all corky and woody tissues, as the skins of fruits, tubers, and cereals, are quite indigestible, and that in consequence of their irritating action they hurry food through the alimentary canal, and so occasion waste. It is necessary, therefore, that all such tissues should be removed as completely as possible.

When it is required to obtain the starchy or farinaceous matters of vegetables, one or other of the following processes is followed:—

(*a*). The material is pulped or crushed, and diffused through a considerable volume of cold water. It is then strained and allowed to stand until the farina or starch subsides.

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* The Cantor Lectures, delivered before the Society of Arts.

(*b*). Or it is allowed to pass into a state of putrefactive decomposition, whereby the albuminous matter, as the gluten, &c., decay and leave the starch untouched.

(*c*). Or it is subjected to the action of a weak alkaline solution, generally of caustic soda, which dissolves the gluten and allows the starch to subside. The gluten thus dissolved may be again recovered by neutralising the alkaline solution with acid, and collecting the precipitated gluten, as in the processes of Durand and others.

I have already explained that in the treatment of the ground meal of wheat and other grain the bran and coarser kinds of flour are separated by sieves of different degrees of fineness, and that in this manner about eight or nine varieties of product are obtained, as biscuit flour, best or fine households, seconds, tails, fine sharps or middlings, coarse sharps, fine pollard, coarse pollard, and long bran; the proportions of these from ordinary brown meal will vary according to circumstances, but processes have been invented, as by M. Mége Mouries, M. D'Arblay, and others, whereby the yield of fine flour is increased to 86 or even to 88 per cent of the grain, and by which the quantity of gluten is also regulated.

When the flour is rich in gluten, as in the case of the hard wheats of Sicily, Russia, Sardinia, and Egypt, they are well suited for the manufacture of certain granular powders and dried pastes, which are known as Semola, Semolina, Soujee, Mannacroup, Maccaroni, Vermicelli, and Cagliari paste. The last three are generally imported from Naples or Genoa, where they are made from a highly glutinous wheaten flour, by kneading it into a thin dough or tenacious paste, and then forcing it through holes or slits in a metallic plate. In this way the several varieties of pipe, celery, and ribbon maccaroni are obtained; and the fancy forms of it, called Cagliari paste, which are in the shape of stars, rings, Maltese crosses, &c., are produced by stamps. All these varieties of raw wheaten paste are cooked by boiling or baking, and are associated with soup or beef tea, or milk, or are mixed with eggs, cheese, &c.

The best variety of flour for bread is that which contains less gluten than the preceding, as from 8 to 10 per cent of it instead of from 12 to 14 or 15. Dantzic flour, and soft Spanish, as well as the American called Genessee, are the best examples of it, and are highly esteemed by bakers on account of the fine quality of bread which is procurable from them; the richer varieties of hard glutinous wheat being used only to impart strength to weak and inferior descriptions of flour.

Bread, which is the most important preparation of flour, owes its value as an article of diet to a good and equable vesiculation of the dough, the vesiculation being effected by the diffusion of small bubbles of carbonic acid gas throughout its substance; and, as this vesiculation can only take place in a proper manner when the gluten of the flour is in sufficient quantity, and of good quality, it is, to some extent, a test of the goodness of the meal. Those flours which contain too little gluten, or gluten which is deficient of strength, cannot be vesiculated into bread. This is the case with almost every description of flour, excepting that of wheat and rye.

The most common, and also the most ancient method of vesiculating bread is by fermentation; and the process is not very different from what it was in very early times, when we were told that "a little leaven leaveneth the whole lump." Yeast of some sort—as brewer's yeast; or patent yeast, prepared from infusion of malt and hops; or German yeast, which is the solid residue of the yeast produced by the fermentation of rye for making Hollands; or baker's yeast, which is made from potatoes and flour; or leaven, which is old dough in a state of fermentation, is mixed with the flour or dough, which soon begins to ferment by the action of the yeast fungus (*micoderma cerevisiæ*) on the sugar of the flour. Carbonic acid is thus produced; and by being diffused through the substance of the dough, it vesiculates it, and causes it to rise or swell. The most usual practice with the baker is somewhat as follows:—A special ferment is prepared from mealy potatoes (technically called fruit) by boiling them in water, mashing them, and allowing them to cool to a temperature of about 80° Fahrenheit. Yeast is then added to them, together with a little flour to hasten the fermentation. In three or four hours, at a proper temperature (as from 80° to 90° Fahr.), the whole mass is generally in a state of active fermentation, with a sort of cauliflower head. It it then diluted with water and strained, and is mixed with sufficient flour to make a rather thin dough, which in about five hours rises to a fine sponge. This is again diluted with water containing salt, and is worked with the necessary quantity of flour into dough, and allowed to stand for two or three hours, when it rises, and is in a fit condition to be baked into loaves.

It can hardly be said that the potatoes are an adulteration in this case, for they do not ever amount to more than 6 lbs. to a sack of flour, which makes about 380 lbs. of bread, or 95 4-lb. loaves. The salt is added to the extent of about 4 lbs. or more to a sack of flour, the proportions being regulated according to circumstances, for the object of it is to improve the quality of the loaf as regards whiteness, firmness, and flavour.

There is, no doubt, a slight loss of nutritive matters by this mode of vesiculation, for a small portion of the sugar of the flour is converted into alcohol and carbonic acid, but the quantity is so inconsiderable as to be undeserving of notice. The advantage of the process, however, is that it is an excellent test of the quality of the flour; for weak flour, or flour that has been injured by germination, or by keeping, will not stand the action of yeast, but will be either ropy, or sticky, or heavy, when baked into bread.

Another method of vesiculation is to generate carbonic acid in the dough by the action of an acid on bicarbonate of soda. Dr. Whiting's process, which was patented in 1836, was to mix the carbonate of soda with the flour, and then to act on it with a proper proportion of muriatic acid added to the water. He used from 350 to 500 grains of carbonate of soda to 7lbs. of flour, and to this he added 2¾ pints of water charged with from 420 to 560 grains of muriatic acid. Other proportions are used by bakers who make unfermented bread; but in all cases the proportions should be such as to form common salt (which is the product of the action of muriatic acid on carbonate of soda)—the carbonic acid being liberated in the substance of the dough. Care should be taken that the muriatic acid is pure, for that found in commerce is generally highly charged with arsenic.

In 1845, another acid was patented instead of muriatic—viz., tartaric; and the various preparations called baking-powders, custard-powders, egg-powders, &c., are nothing but mixtures of tartaric acid and carbonate of soda, with a little farinaceous matter, the common proportions being 1 part of tartaric acid, 2 of carbonate of soda, and 4 of potato-flour or other dry starch, with a little turmeric powder to give it a rich yellow tint. When this is mixed with flour and wetted, it effervesces, as in the case of a common seidlitz powder, and so diffuses the carbonic acid through the dough.

Very lately Mr. McDougall has proposed the use of phosphoric acid as a more natural constituent of food than the preceding, and this, with an alkaline carbonate, forms the preparation which is known as phosphatic yeast.

A third process, which is now extensively used in the vesiculation of bread, is that of Dr. Dauglish, and by which the bread called aërated bread is obtained. It consists in the addition of a solution of carbonic acid in water to flour under pressure. The mixture is made in a closed air-tight vessel, in which the dough is well kneaded by machinery, and directly the outlet of the vessel is opened, and the pressure thus removed, the gas escapes from the water, as in the case of an uncorked bottle of soda-water, and expands into little bubbles within the substance of the dough. By its expansion, also, it forces itself out of the mixing chamber, and rises into a spongy dough.

In all cases, however, where carbonic acid is generated within the dough by other processes than fermentation, the dough must be baked immediately, or it will fall, and the loaf be heavy. Various contrivances have been suggested for helping the process of kneading, which is laborious, and sometimes not altogether cleanly work. Mr. Stevens' hand machine appears to accomplish this very well. It is in use in the Holborn Union, where about 5,633 lbs. of bread are made every week by one man and two boys; and they contrive to make ninety-six 4-lb. loaves out of every sack of flour (280 lbs.). The materials used on the average of a whole year being as follows:—

PROPORTIONS PER WEEK.

	lbs.	
Flour..	4,129	Which produce 5,633 lbs. of bread, or 1,408 4-lb. quartern loaves.
Cones	140	
Potatoes	168	
Salt	68	
Malt	13	
Hops..	1½	

The potatoes, the malt, and the hops, are for the purpose of making the yeast or ferment for the bread.

But, by whatever process bread is made, it is necessary to observe certain precautions to ensure the production of a good loaf.

1st. The flour should be from sound grain, sufficiently rich in good gluten.

2nd. The yeast should be sweet, and should show a lively action in the sponge.

3rd. The dough should be well kneaded to insure the thorough diffusion of the gas, and to give toughness to the gluten.

4th. The salt should be used in such proportion as to regulate the fermentation, and give firmness to the gluten, whiteness to the bread, and a good flavour.

5th. The baking should be so managed as to ensure the thorough heating of the loaf to the temperature of at least 212° Fahrenheit, in order that the insoluble starch may be changed by the heat into soluble dextrine; and the crust should be light-coloured and thin. This is best effected when loaves are baked singly, as on the Continent, and not in batches, as with us; for in the last case, the top and bottom crusts are thick and hard, and are frequently scorched, while the interior of the loaf is doughy and underdone.

Specimens of the different kinds of bread of England and the Continent are upon the table; and you will notice the dark colour of the rye-bread of Europe. I am indebted for these illustrations to the kindness of Mr. Twining, who has liberally placed the valuable collection of foods in his museum at our disposal. Here, also, is a sample of rye-bread supplied by Mr. William Ray Smee, who, in the interest of the poor, has had it made according to the formula of the Board of Agriculture of 1795. It consists of one part of rice and four parts of rye, ground together and sifted in the usual manner. The meal is then made into dough with yeast; and when fermented is baked in the form of long rolls. The bread is very dark, like all rye-bread, and has a close texture, but it is agreeable to the palate, and is very nutritious. The great recommendation of it is its cheapness, for it can be made at less than a penny a pound, and is therefore a very suitable bread for the poor.

Those flours which do not contain sufficient gluten of the proper quality for fermentation or vesiculation—as barley-meal, oat-meal, Indian-meal, and the flour of peas and lentils, are best cooked by baking them in the form of cakes or biscuits—a practice which is as ancient as the time of the Patriarchs, when, during the Passover, they were commanded to eat unleavened bread. The chief food of the common people of Rome was a heavy kind of unleavened bread, like the present polenta of the Italians, which is made of Indian meal and cheese. As in former time, biscuits and unfermented cakes are made from meal or flour mixed with water and baked; but the texture of the substance is close, and it is not easy of digestion unless it is thoroughly disintegrated. When biscuits are lightened by means of egg and sugar, with a little butter, they are much more digestible; and they are still more so when they are vesiculated and puffed up by means of a small quantity of carbonate of ammonia, as in the case of cracknells and Victoria biscuits.

The so-called farinaceous foods for infants are only baked flour, sometimes sweetened with sugar. The flour must be baked until it acquires a light-brown colour, the temperature being about 400° or 450° Fahrenheit. The granules of starch are then disintegrated, and converted into a soluble substance, named dextrin—which, by a further process of cooking or boiling, as in making pap, forms, when properly sweetened, a very excellent food for children. Tops and bottoms owe their value to the same circumstance—viz., that the farinaceous matter, which is so indigestible with infants, is broken up by baking into soluble dextrin.

All varieties of meals and arrowroots are easily cooked by stirring them into boiling water, or boiling milk, until they have the consistence of gruel or hasty pudding, and then boiling for a few minutes. In the case of Indian-meal, rice, split-peas, lentils, and haricots, the boiling should be continued for a considerable time, and the whole grain should be previously steeped in water for many hours; for the starch and cellulose of these vegetables are not digestible unless they are thoroughly disintegrated by cooking. It may be said, indeed, that all vegetables with dense tissues require prolonged boiling to cook them, for cellulose is not capable of digestion by man unless it is broken up by the action of heat—even starch is likely to pass through the alimentary canal unchanged, if it be not rendered soluble by fermentation or cooking. It is an important question, whether in utilising starchy foods it may not be advantageous to help their transformation by allowing the grain to germinate to some extent, as in the process of malting, when the starch is changed into sugar. Mr. Lawes has examined this question, and has concluded, from his experiments on stock, that in the case of pigs and bullocks the fattening effect of the grain is not increased; but it may be different with the human stomach, where the transformation power is not nearly so active as with lower animals. Here, in fact, is an example of it:—The food which Liebig recommends for infants is a preparation of malt with wheaten flour and milk, to which a little bicarbonate of potash has been added; and the reputation of it in Germany, as an article of diet for children, is considerable. The preparation is made by mixing 1 oz. of wheaten flour with 10 oz. of milk, and boiling for three or four minutes; then removing it from the fire, and allowing it to cool to about 90°. One ounce of malt-powder previously mixed with 15 grains of bicarbonate of potash, and 2 ozs. of water, are then stirred into it, and the vessel being covered, is allowed to stand for an hour and a half, at a temperature of from 100° to 150° Fahrenheit. It is then put once more upon the fire, and gently boiled for a few minutes. Lastly it is carefully strained, to remove any particles of husk, and then it is fit for the child's food. The composition of the food, according to Dr. Liebig, is as follows:—

Foods.	Plastic matter. ozs.	Carbonaceous matter. ozs.
10 oz. milk	0·40	1·00
1 oz. wheat-flour ..	0·14	0·74
1 oz. malt-flour.. ..	0·07	0·58
	0·61	2·32

The relation of the plastic to the carbonaceous being as 1 to 3·8, which is the right proportion for the food of children.

The effect of the malt-flour is to transform the starch into glucose, and thus the mixture gets thinner and sweeter as it stands; and the bicarbonate of potash is added to facilitate the change, and to neutralise the acid constituents of the flour and malt.

Liebig's extract of malt is another such preparation for a quick assimilation of starchy matters.

Vegetable substances are occasionally fermented, either for the purpose of increasing the relative amount of glutinous matter, or for the purpose of rendering them acid. Potatoes, for example, as well as barley, wheat, and rye, leave a residuum after fermentation, which contains more gluten than the original substance, in consequence of the transformation of sugar and starch into alcohol; and although the residuum is coarse, and is hardly suited for human consumption, yet it is an excellent food for cattle; in fact, in Germany it is often eaten by the poor.

When the process is carried still further, and the mass acquires an acid property in consequence of the formation of acetic, butyric, and lactic acids, various sour preparations are obtained, which are no doubt useful in assisting the digestion of other foods. The ancient Romans had many such fermented substances which were not unlike the sauer-kraut of the Germans. This, as you know, is made from the leaves of cabbages, gathered generally in autumn, and from which the stem and mid-rib are removed. They are cut up into thin slices, and are placed in a tub or vat, alternately with layers of salt, until the vessel is full. It is then subjected to pressure, and allowed to stand for five or six weeks (according to the temperature); the lactic fermentation is thus set up, and the mass becomes sour. It is cooked by stewing it in its own liquor with bacon, pork, or other fat meat; and certain condiments, as dill or carraway, are added to improve its flavour. In Prussia, and in many parts of Germany, there is a similar preparation of fermented beans; and in Holland and the South of Europe cucumbers are fermented. We also have our pickled vegetables, in which acetic acid takes the place of lactic acid. All these preparations are no doubt aids to digestion, especially when the fibre of meat is tough, and contains tendon, or hardened cellular tissue. This is especially so with salted meat, and, therefore, a little pickle is always a good and palatable addition to cold boiled beef.

Vegetable substances, as tea, coffee, maté, cocoa, &c., the infusions of which are used as beverages, are prepared for commerce in nearly the same manner. When taken from the tree, and while in a fresh condition, they are allowed to undergo a moderate kind of fermentation, and they are then dried and roasted. In the case of tea, the roasting operation is performed during the process of drying and curling, by heating the leaves upon wire-sieves held over a charcoal fire, but cocoa and coffee are roasted in metallic cylinders, which are kept revolving over a clear fire—coffee being roasted until it is partially charred, and has lost from 14 to 20 per cent in weight. By this means the aroma or volatile oil is, in each case, produced; and there is also an empyreumatic change in the astringent acids, the sugar, the gum, and the starch, whereby extractive matters, varying in amount and quality, according to the degree of heat, are formed. Shrader has examined the subject in respect of coffee, and has ascertained that the following are the proportions of the several constituents of raw and roasted coffee:—

	Raw Coffee.		Roasted Coffee.
Peculiar coffee principle ..	17·58	..	12·50
Gum and mucilage..	3·64	..	10·42
Fatty matter and resin	0·93	..	2·08
Extractive	0·62	..	4·80
Woody tissues and cellulose	66·66	..	68·75
Mixture, &c.	10·57	..	1·45
	100·00		100·00

Infusions of tea and coffee should be made with boiling water, but they should never afterwards be boiled, for the aromatic principle is very volatile, and would be thus lost; besides which a decoction of tea or coffee is disagreeably bitter on account of the solution of the coarse forms of extractive matter. Soft water also extracts these matters, and, therefore appears to give a stronger infusion than moderately hard waters, but it is always at a sacrifice of delicate flavour. Excellent tea is made in London with water of 14 or 15 degrees of original hardness, and of about 5 degrees when boiled. This was a subject of investigation by the Government Chemical Commission (Professors Graham, Miller, and Hofmann), who were appointed in 1851 to inquire into the chemical quality of the water supply of London; and they reported that in their experiments they found that tea made from the boiled London water of 5 degrees of hardness could not generally be distinguished from tea made with water of 2½ degrees only, although a delicate palate would recognise a slightly increased bitterness without any enhancement of flavour in the latter. It would seem, indeed, that moderately hard water makes the best flavoured tea, provided it is allowed to stand upon the tea sufficiently long. In the case of the Greenwich pensioners the tea was made from water of 24 degrees of hardness before boiling, and 18·6 degrees after; but the infusion was maintained for half an hour by surrounding the vessel with a steam case; and thus an excellently-flavoured tea was obtained. The Commissioners indeed truly remark, that "where any great loss of strength of tea infusion has been observed in passing from a soft water to a harder, it may be probably referred to the circumstance that the mode of infusing it has not been properly adapted to the hard water; and then there is doubtless some waste of tea." Lake waters have been a good deal extolled on account of their softness and supposed fitness for making tea, solely because they happen to produce a deep-coloured solution, which conveys a false notion of strength; but, in reality, flavour is always sacrificed for the mere look of the thing, there being no increase of physiological or dietetical property. The Chinese, who are very good authorities on this subject, never use either very soft or very hard waters, for their rule is to take the waters of a running stream—"best from the hill side, and next from a river." We may conclude, therefore, that water of from 4 to 7 degrees of hardness after being boiled, is best suited for infusions of tea and coffee; for such water dissolves the aromatic and physiological constituents, without extracting the disagreeable bitter principles. In the case of coffee, in fact, a little acid, as a portion of lemon juice, improves the flavour, notwithstanding that it adds to the hardness of the infusion. Experimentally, it is found that infusions of tea and coffee are strong enough when the former contains 0·6 per cent of extracted matter, and the latter 3 per cent, so that a moderate-sized cup (5 oz.) should contain about 13 grains of the extract of tea, or 66 grains of coffee. These proportions will be obtained when 263 grains of tea (about 2½ teaspoonfuls), or 2 ozs. of freshly roasted coffee are infused in a pint of boiling water; and the amounts of the several constituents dissolved are about as follows:—

Constituents.	Tea. grs.		Coffee. grs.
Nitrogenous matters	17·2	..	44·0
Fatty matter	—	..	3·0
Gum, sugar, and extractive ..	31·7	..	103·2
Mineral matters	9·1	..	22·8
Total extracted	58·0		173·0

So that tea yields to a pint of fresh water about 22 per cent of its weight, and coffee about 20 per cent. Lehmann found that only 15½ per cent of tea was dissolved by water; whereas Sir Humphrey Davy estimated it at 33⅓ per cent. No doubt the quality of the water, as well as that of the tea, affects the results, for distilled water will extract from 40 to 44 per cent of black tea, and nearly 50 per cent of green; but for all this, about 22 per cent is a good average.

Tea is generally measured into the tea-pot by the spoonful, and Dr. Edward Smith has made a curious inquiry into the average weights of a spoonful of different kinds of tea. The results are here shown:—

WEIGHT OF A SPOONFUL OF TEA.

Black Teas.	Grs.	*Green Teas.*	Grs.
Oolong	39	Hyson	66
Congou (inferior)	52	Twankay	70
Flowery Pekoe	62	Fine Imperial	90
Souchong	70	Scented Caper	103
Congou (fine)	87	Fine Gunpowder	123

From which it would seem that from three to seven teaspoonfuls of black tea, or from two to four of green, are required for a pint of infusion of the strength already given.

Cocoa is best made by boiling the mixture for a little while, for it nearly always contains a large proportion of starchy matter, which has been added to dilute the rich fat of the cocoa. Indeed cocoa contains so much butter or solid fat (from 48 to 50 per cent), that it is necessary to reduce it with some easily-digestible substance, as starch, lentil powder, carageen moss, Iceland moss, sugar, &c.—hence the various preparations of it, called granulated cocoa, soluble cocoa, chocolate, &c., the processes for making which I will briefly describe. When the berry is roasted and is cold, it is passed through a machine called a "kibbling-mill," which deprives it of its husk, and of the thin skin which surrounds the kernel or nib. If the nibs thus cleaned are ground in proper mills they form the variety of cocoa called flaked cocoa, but if other preparations are to be made, the nibs are ground between heated rollers or otherwise, until they form a smooth paste, when the diluting substances are mixed with it and are thoroughly incorporated. If soluble cocoa is to be made, the diluting material is sugar with some kind of arrowroot, as tous-les-mois, maranta, curcuma, &c. If chocolate is required, the diluting material is sugar only, with some flavouring agent, as vanilla; and if fancy preparations, as carageen moss cocoa, Iceland moss cocoa, lentil cocoa, &c., are required, then these several substances are incorporated. Granulated cocoa is a preparation of cocoa, with sugar and starch so ground as to form a coarse powder, in which the particles of broken cocoa are covered with a layer of sugar and starch. It is obvious that whenever the mixture consists of starch or other farinaceous substance, the solution of the cocoa preparation must be boiled; but when sugar has been used, as in chocolate, which is the most ancient preparation of it, the combination is such as to require no culinary treatment, or, at most, the action of boiling water or boiling milk.

It is remarkable that, although cocoa is much less used than either tea or coffee, yet it was known in Europe a century before either of the others. As early, indeed, as 1520 it was brought from Mexico by Columbus, who found it the common beverage of the people; and when Cortes was entertained at the court of the Aztec Emperor, Montezuma, he was treated to a sweet preparation of the cocoa, called chocollatl, flavoured with vanilla and other aromatic spices, and served to him in a golden vessel. The Spaniards thus acquired a knowledge of the berry and of its chief preparation, which they kept secret for many years, selling it very profitably as chocolate to the wealthy and luxurious classes of Europe. It was, however, an expensive preparation, and did not come into general use until long after the public coffee-houses of London were established. The earliest notice of it, according to Hewitt, is in Needham's *Mercurius Politicus*, for June, 1659, wherein it is stated that "chocolate, an excellent West India drink, is sold in Queen's Head Alley, in Bishopsgate Street, by a Frenchman, who did formerly sell it in Gracechurch Street and Clement's Churchyard, being the first man who did sell it in England;" and its virtues are highly extolled. This was about five years after the London coffee-houses had been established—for the first of them is said to have been opened in 1650, by a Levantine named Pascal Rossee, in St. Michael's Alley, Cornhill; and a year after they were opened in Paris and in Holland. In 1660 they were so much frequented, and coffee was so largely drunk, that they were made a source of revenue, a tax of 4d. a gallon being levied on all the coffee drunk in them; and three years later they were regularly licensed at the Quarter Sessions like common taverns. In 1668, when Ray, the distinguished naturalist, published his "History of Plants," he tells us they were as numerous in London as at Cairo; and at last they became so great a nuisance, on account of their political associations, that in 1675 Charles the Second endeavoured to suppress them by proclamation, calling them seminaries of sedition; but the keepers of them were sufficiently powerful to make him revoke the prohibition. The history of these houses would form a curious chapter in politics and literature, for they are associated with the earliest development of free political discussion, and with the greatest names in English literature. Among the oldest of them is the "Grecian," where Shakespeare and Rare Ben were frequent visitors; and hardly less ancient is "Wills," where Dryden held forth with pedantic vanity, and where the foundation was laid for that critical acumen which soon became a distinguishing feature in English Literature. In the city, too, there was "Garraway's," where not only was tea first sold, but where, in Defoe's time, "foreign banguiers," and even ministers resorted to drink it. "Robins" and "Jonathans," and the "Cocoa-nut Tree," in St. James Street, were also famous, and had their distinguished followers.

(To be continued).

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 3rd, 1868.

J. P. JOULE, LL.D., F.R.S., &c., President, in the Chair.

"*Remarks on Mr. Baxendell's Laws of Atmospheric Ozone*," by Professor W. STANLEY JEVONS, M.A.

In reading the remarks of Mr. Baxendell on atmospheric ozone, it occurs to me that a very simple explanation can be given of the connection he detects between the height of the clouds and the amount of ozone at the surface, two facts which seem at first sight entirely unrelated. The quantity of ozone which reaches the surface will depend on three circumstances:—

1. The thickness of the current of air touching the surface.
2. The proportion of ozone existing therein.
3. The degree in which this current is rendered uniform by constant mixture.

The balloon observations of Mr. Glaisher proved what was previously inferred by meteorologists, that the atmosphere usually consists of several strata of air which are separated by distinct boundaries, and do not freely mix. Hence it is only the ozone in the lowest stratum which is usually available at the surface, and its quantity will be proportioned, *ceteris paribus*, to the thickness of that stratum. It is the height of the first layer of clouds which usually defines the upper limit of this stratum. For during my own observations both in Australia and England I have often noticed that smoke from a great town or from extensive bush fires rises only to a definite height, and seems to form the basis, as it were, of the cumulous clouds, which are the upward terminations of ascending currents. Now, as in May the height of this stratum according to Mr. Crosthwaite's observations, greater than in any other month, there will be a larger mass of air which can successively come in contact with the surface and furnish ozone. But we shall only have the full benefit of this ozone when an active process of mixture is going on. At night the air in contact with the earth is cooler than that above, and therefore tends to lie in a stagnant layer, which can often be detected by the mist or smoke which it contains. This layer will be rapidly exhausted of ozone, and will be filled with the organic exhalations from the earth. Hence arises the comparatively unhealthy character, and in some climates the poisonous nature, of night air, and it may constantly be observed that a moderate wind may be blowing above our heads, as shown by the motions of the clouds or the wind felt on a mountain top, without breaking up the stagnant layer on the surface. This is one reason why the air is calmer at night than in the day. But during high winds the gusts penetrate to the surface and prevent any stagnation, so that, as I apprehend, during stormy weather the deficiency of ozone in the evening would not be observed.

In the day time, on the contrary, the sun's heat occasions a perpetual circulation or convection in the lowest mass of air up to the level of the cumuli. Every portion of the air is thus successively brought to the surface and organic substances are carried off and oxidated.

During my own observations on ozone I felt strongly the imperfections of the method of measurement alluded to by Mr. Baxendell, and I thoroughly agree with him that the mysterious variations of ozone will not be understood until not only the quantity of air brought into contact with the paper be measured or regulated, but the varying source and magnitude of supply be considered.

Mr. E. **Bowman**, M.A., exhibited and explained Mr. Barrett's modification of Professor Wheatstone's Kaleidophone.

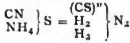
Professor H. E. **Roscoe**, F.R.S., drew attention to the important discovery, made independently by M. Janssen at Guntoor in India, and by Mr. Norman Lockyer in London, of the visibility of the spectral lines of the red solar prominences under ordinary circumstances. Hitherto these protuberances or red flames have only been seen during total eclipses of the sun; but by the application of the spectroscope in conjunction with the telescope, the peculiar bright lines which these prominences exhibit, indicative of the presence of glowing gas, can now be observed whenever the sun is visible. Although the priority of this interesting discovery is due to M. Janssen, who first observed the protuberances the day after the eclipse, the method having occurred to him whilst observing during the eclipse, yet Mr. Lockyer had suggested this particular method of examination no less than two years ago, and had succeeded in his endeavour before he became aware of M. Janssen's prior observations. From the accounts as far as they are yet published, we learn that the bright lines appear to be identical with those of hydrogen.

Mr. **Baxendell** stated that this discovery would give a great impetus to the progress of our knowledge of solar phenomena, and that the importance of observations on this plan could not be over-estimated.

Professor H. E. **Roscoe**, F.R.S., exhibited and explained Carré's apparatus for freezing water by its own evaporation, and by means of which a pint of water was frozen in a few minutes.

DUBLIN SCIENTIFIC CLUB.

The ordinary meeting of this club was held in the Lecture Theatre of the Royal Dublin Society. Professor Ball gave a communication "On Lord Rosse's New Drawing of the Nebula in Orion." Mr. Tichborne gave a verbal description of an "Anomalous Reaction observed in connection with Nitrites present in Well Water." Other communications were received as follows:—Mr. Thornton, "On Peculiar Nodules in Sandstone;" Mr. Yeates, "On Sprengel's Air Pumps;" Mr. Johnstone Stoney, "On Huggins's Researches on Sidereal Astronomy" (see *Proceedings of Royal Society*, No. 105); Dr. Emerson Reynolds, "On Schönbein's Test for Prussic Acid." The same gentleman gave a verbal description of some experiments which he shortly intends to publish, viz., "On the Isolation of Sulphur Urea," (sulphocarbamide). Dr. Reynolds seems to have formed this substance, which hitherto has not been known in an isolated condition. In his investigation in connection with sulphocyanide of ammonium, which has extended over some considerable time, he found that on heating that substance for some time to its melting point, and then extracting with alcohol, he obtained a white crystallisable substance, which, on analysis, answered to the formula of sulphur urea:—

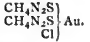


$$\left.\begin{matrix}CN\\NH_4\end{matrix}\right\}S = \left.\begin{matrix}(CS)''\\H_2\\H_2\end{matrix}\right\}N_2.$$

The cause of failure in forming this substance must have been from the fact that sulphocyanide of ammonium was either heated to too high or to too low a temperature.

The following compounds were also described:—

1. Gold compound—

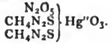


$$\left.\begin{matrix}CH_4N_2S\\CH_4N_2S\\Cl\end{matrix}\right\}Au.$$

2. Platinum compound—

$$\left.\begin{matrix}CH_4N_2S\\Cl_3\end{matrix}\right\}Pt'''' + HCl.$$

3. Mercurial compound—



$$\left.\begin{matrix}N_2O_5\\CH_4N_2S\\CH_4N_2S\end{matrix}\right\}Hg''O_3.$$

FOREIGN SCIENCE.

Paris, Nov. 18, 1868.

New Uses for Mica.—Influence of Coloured Rays on the Decomposition of Carbonic Acid by Plants.—Naphthaline Scarlet Academy of Sciences: Dispersive Power of Gases and Vapours.—Facts serving to Complete the History of the Bodies of the Stilbic Series.—On the Mixtures of Gold and Silver from Kongsberg.

Few uses to which mica can be placed have been found up to the present time. M. Puscher lately drew the attention of the Industrial Society of Nuremberg, to the Siberian mica, which occurs in very fine plates, and indicated some new purposes to which it could be applied. When the thin plates of mica are cleaned with concentrated sulphuric acid, and silvered in the same way as glass, they take a lustre similar to that of silver, and being pliable they can be employed in the covering of various ornaments. By heating the thin plates, and afterwards exposing them for a very short time in a muffle heated to bright redness, an aspect of matted silver is given. It is necessary to avoid heating the mica too long or too powerfully, since in either case a yellow shade is communicated, as well as great brittleness. The silvery substance formed is distinguished from metals by the property of resisting nearly all reagents; it is not in the least altered by sulphuretted combinations, by the sun, water, air, concentrated acids or alkalies.

M. Cailletet has published a research "On the Influence of Various Coloured Rays on the Decomposition of Carbonic Acid by Plants." In the experiments here recorded, M. Cailletet made use of covers or bells formed of plates of coloured glass united to each other by plates of lead. It was established in the first place to render the results comparable, that leaves of the same plant and of equal surfaces decompose sensibly the same volumes of carbonic acid when they act on identical gaseous mixtures exposed to the same luminous source. Coloured leaves, which nearly always contain a certain quantity of chlorophyl, decompose carbonic acid equally, but slowly, while the entirely white parts of the leaves of the *Aspidistra elatior*, and several other plants are without decomposing action. All green plants do not act with the same energy on carbonic acid; there are very sensible differences which have already been signalised, but not completely examined. The absorption of carbonic acid and the disengagement of oxygen more or less mixed with nitrogen appertain exclusively to the parts of the plants which contain the green matter; but it is indispensable that these organs be intact, for in scraping or even rubbing them this property is permanently destroyed. A leaf may, however, be cut carefully into very small pieces, and still each piece, containing all the anatomic elements, possess the decomposing property. A little apparatus was constructed of two vessels soldered at the base, and having an opening at the top where a concentrated solution of iodine in bisulphide of carbon could be introduced. With this disposition, the solution being permeable only to the obscure rays of heat, carbonic acid mixed with air suffers no decomposition, notwithstanding the prolonged action of solar rays. The divers coloured rays have, on the contrary, a special action, more or less powerful on the dissociation of carbonic acid. An examination of the tabulated results obtained by M. Cailletet shows that the calorific rays as well as the chemical rays are without action on the dissociation of carbonic acid by plants. It would seem, from an inspection of these results, that the colours the most active in a chemical point of view (in regard to the colouration of chloride of silver, *e.g.*) are those which favour the decomposition of carbonic acid the least. Yellow induces the largest decomposition, and red next; violet and blue affect it but little. With green light, whether from the colour contained in vegetables, or from solutions or coloured glass, the action is peculiar. Under this influence the decomposition of the carbonic acid is *nil*, a new quantity of this gas is on the contrary produced by the plants.

A new colour, naphthaline scarlet, has been obtained by M. Schiendel. After producing nitronaphthaline, by acting upon naphthaline with nitric acid not stronger than 45°, in the cold, he transformed it into naphthylamine by the ordinary reducing methods. Among other reducing agents, he tried zinc in impalpable powder in the presence of an alkali; with the naphthylamine furnished by this reaction, M. Schiendel obtained a new colouring matter which the other naphthylamines do not give. This point established, he endeavoured to isolate the new alkaloid, which gives birth to the colouring matter. Fractional distillation gave it in an almost state of purity. It is a liquid, crystallising somewhere about 0°; it distils at a higher temperature than naphthylamine. The base is oxygenated and can form salts. The method of operating to obtain the naphthaline scarlet is as follows:—

1. The oily alkaloid is heated with nitrate of protoxide of mercury, as in the preparation of nitrate of rosaniline; there is thus formed a brown colouring matter which is isolated from the mercury and tarry products formed.

2. This brown colouring matter is afterwards mixed with a proportional quantity of naphthylamine, and heated until the fawn tint is completely changed. The red colouring matter has then to be purified by the employment of the ordinary means for aniline colours. In the pure state the colouring matter is solid, reflecting light brilliantly, and soluble in alcohol; it dyes all fibres. No detailed method can be given; unfortunately the production of this alkaloid is uncertain, sometimes even none is obtained.

At the *séance* of the Academy on the 5th of October the following memoirs were communicated:—"Researches on the Mecanics of Atoms," by M. Lucas; "On the Dispersive Power of Gases and Vapours," by M. Croullebois; "On some Facts serving to complete the History of the Bodies of the Stilbic Series," by M. Zinin; "On Isopropylcarbylamine and Isopropylamine," by M. Gautier; "Observations relative to the Preservation of Wood," by M. Boucherie; "On the Mode of Testing Colouring Matters, and especially Logwood, by Dyeing," by M. Houzeau; "On the Mixtures of Gold and Silver from Kongsberg," by M. Hiortdahl; "Note on a New Element of the Pile," by M. Ney; "Note on the Geological Constitution of the Neighbourhood of Thebes," by M. Delanoue; and "Remarks on the Fossils from the Neighbourhood of Thebes, and Classification of the Beds containing them," by M. D'Archiac.

M. Zinin states that chlorobenzile heated with water in a sealed tube to 180° C. is completely decomposed into benzile and hydrochloric acid—

$$C_{14}H_{10}OCl_2 + H_2O = C_{14}H_{10}O_2 + 2HCl.$$

Heated with alcohol, it is decomposed more easily at a lower temperature into benzile, chloride of ethyl, and hydrochloric acid—

$$C_{14}H_{10}OCl_2 + C_2H_6O = C_{14}H_{10}O_2 + C_2H_5Cl + HCl.$$

Chlorobenzile heated to 200° with an equivalent quantity of pentachloride of phosphorus, is converted into a body having the composition $C_{14}H_{10}Cl_4$. This quadrichlorinated compound is only slightly soluble in ether and alcohol, and insoluble in water. It is difficultly attacked by nitric acid, a nitrogenous product being the result. It is not converted into benzol by the action of superheated water and alcohol. In boiling alcohol it is easily decomposed by sodium amalgam and converted into a hydrocarbon, the composition of which is expressed by the formula $C_{14}H_{10}$. No accessory products are formed, the reaction is simple—

$$C_{14}H_{10}Cl_4 + 4Na = C_{14}H_{10} + 4NaCl.$$

Chlorobenzile dissolved in alcohol and submitted to the action of zinc and hydrochloric acid, is soon transformed into nearly pure desoxybenzoin; the reaction is expressed by the equation—

$$C_{14}H_{10}OCl_2 + 2HCl + 2Zn = C_{14}H_{12}O + 2ZnCl_2.$$

The preparation of desoxybenzoin by the action of reducing agents presented some difficulties; now after having found so convenient a reaction, M. Zinin has been enabled to prepare this body in sufficient quantity to continue his researches on its metamorphoses. Among other results, M. Zinin has found that by reacting with sodium amalgam upon the product of the action of pentachloride of phosphorus upon desoxybenzoin, stilbene is obtained. The reactions are expressed by the two equations—

$$C_{14}H_{12}O + PCl_5 = C_{14}H_{11}Cl + POCl_3 + HCl.$$
$$C_{14}H_{11}Cl + 2Na + H_2O = C_{14}H_{12} + NaCl + NaHO.$$

If the oily product obtained by the action of pentachloride of phosphorus upon desoxybenzoin be treated with potash and distilled or heated to ebullition, crystals of tolane ($C_{14}H_{11}Cl$) are obtained. Thus M. Zinin remarks, by a series of reactions easily understood, one is enabled, in separating the benzoin, to form hydrocarbons which can serve as the point of departure for forming benzoin, and consequently all the bodies of the stilbic series.

The native silver found at Kongsberg always contains a little gold, the proportion of which, according to numerous analyses, varies from 0·002 to 3 per cent. Rich mixtures of gold are actually very rarely found. According to the researches of M. Hiortdahl, it seems probable that these mixtures occur in quartz veins of a different character to the ordinary argentiferous veins, which are filled with calcspar as the principal mineral. As to the composition of the mixtures of gold and silver from Kongsberg, M. Hiortdahl can only find a single indication in mineralogical literature, an analysis by Fordyce in Brooke and Miller's "Mineralogy;" the gold is there given at 28 per cent. The following results for similar mixtures are those of M. Hiortdahl in conjunction with M. Samuelsen:—

Locality.	Mines.	Percentage of Gold.
Bestandige	Liebe	53·1
Louise..	Augusta	50·0
Froken	Christiane ..	45·0
Incog.	(Fordyce's result) ..	28·0
Blaarud	Christiane ..	27·0
Froken	„	26·9

Although the differences in the analytical results would scarcely suggest perfectly definite chemical combinations, it may at the same time be remarked that the proportions of gold indicated seem to relate to two distinct groups, approaching in composition $AuAg$ and Au_2Ag_3. The numbers found by calculation for these two combinations are 47·6 and 26·7 per cent. These mixtures have a different composition from others of the same class at present known, and which always contain more gold and less silver. The silver which comes from the works sometimes contains a little more gold than the analysis of the argentiferous mineral indicates. The cause of this is that a certain part of the ore is smelted with pyrites containing a little gold, which collects in the melted sulphides (mattes). In these pyrites the gold is probably combined with selenium and tellurium, the presence of which in the mattes is easily proved, in quantity about 0·05 per cent. According to M. Samuelsen, the Kongsberg gold contains 5·5 per cent of platinum and a trace of palladium.

CORRESPONDENCE.

REVERSAL OF THE SODIUM-SPECTRUM.

To the Editor of the Chemical News.

Sir,—It may be worth while to record a reversal of the bright sodium line which I have observed in the spectrum of the mass of flame in a copper smelting furnace. This phenomenon, which it is not quite easy to realise experimentally, is most beautifully seen, and I have no doubt can be obtained as easily from any similar furnace.

The furnace is fired from one end and charged at the other, so that one end is much hotter than the other. On looking into the furnace from the hot end there is seen in the spectroscope a continuous spectrum crossed by a bright sodium line, but on looking in from the cold end a continuous spectrum crossed by an intense dark line is seen. As the furnace becomes hotter the dark line disappears, and is replaced by the bright line; but before this has become permanent the bright and dark lines alternate as the flame flickers, and their exact coincidence can be observed.—I am, &c.,

W. Marshall Watts.

Manchester Free Grammar School.

PERIDOTE METEORS.

To the Editor of the Chemical News.

Sir,—I find in No. 467 of the Chemical News an interesting letter from Dr. Phipson, which contains, besides some very exact remarks, several assertions which late researches have contradicted. It is true that M. Damour, in publishing the analysis of the meteorite of Chassigny, says that it contains no metallic iron whatever, and, he added, that this stone exercised no action on the magnetic needle. Nevertheless experiments lately made at the laboratory of geology of the Museum of Paris, by M. Lawrence Smith—experiments which I have myself repeated and verified—have convinced me that a small quantity of metallic iron does exist in this meteorite.

Besides, without speaking of the stone of Chassigny, it must be remarked, in contradiction to the assertion made by M. Pisani, that many meteorites contain more than 50 per cent of peridote, so that the composition of the stone of Ornans offers nothing particularly remarkable.

I will mention on this subject the meteorite of Sauguis (7th Sept. 1868), of which I lately published the analysis, and which contains more than 60 per cent of peridote. I will remind you also of the stones of Luotalaks, of Bralystock, and of Massing, which all contain more peridote than that of Ornans.—I am, &c.,

Stanislas Meunier.

Aide Naturaliste au Museum,
33, Rue de Vaugerard, Paris.

THE A.B.C. SEWAGE PROCESS.

To the Editor of the Chemical News.

Sir,—I see in your issue of the 6th inst. an article by Dr. Frankland, "On the Purification of Sewage," which appears to be a copy of his report to the chairman of the Royal Rivers Commission on the Leicester sewage experiments. Although these experiments were conducted under my superintendence, the first intimation I had of Dr. Frankland's report was in the public papers. I must, therefore, ask you to allow me space to reply to it in the same way.

The trial of the A.B.C. process was in the strictest sense of the word an "experiment." The plant perfectly adapted for the lime process was in several respects unsuitable for the new one. From this cause several accidents happened; one in particular. mentioned by Dr. Frankland, by which no less than 150.000 gallons of raw sewage were pumped into a tank holding 430,000 gallons of purified sewage. It was impossible to drive this out in less than six or seven hours, and I felt compelled to make a written protest against the samples being taken; nevertheless those from the latter half of the day are to our disadvantage included. From this reason the proportion of suspended matter contained in our effluent water of that day is 4·36 parts in 100,000, while that in the lime purified is 2·84; and it is necessary to bear in mind that by the same accident a portion of the A.B.C. mixture was admitted to the tank containing the lime purified sewage, from which it threw down a further precipitate. This fact is brought out singularly by the comparison of the lime purified water of May 13th with that of this date. Dr. Frankland notices the uniformity in the samples of sewage: the comparison may be shown as follows:—

	Suspended matter in sewage.	Suspended matter in lime purified sewage.
May 13th, 1868 ..	22·12	16·80
July 31st, ,, ..	48·08	2·84

The A.B.C. process suffered during the whole week of the experiments from a continued leakage of the new compound into the lime tanks; during the last day this was at its minimum, and the proportion of suspended matter in the A.B.C. water was considerably less than half that in the lime; clearly, then, the new process has the advantage here. The question of additional solid matter is much modified by the fact that the residue from the lime purified water contains but little water of hydration, while that from the A.B.C. process (in which an excess of alum was too frequently present) contains much. Dried at 212°, as in Dr. Frankland's mode of water analysis, the lime process has a considerable advantage; dried at 302°, the excess is extremely small, and even this would disappear as soon as the proportions were accurately adjusted to the sewage.

But the point which most surprises me is the statement that the purified sewage invariably contains more ammonia than the raw sewage. Dr. Frankland's explanation is partly right, but partly wrong. The A.B.C. compound has the power of slowly converting part of the organic matter dissolved in the water into ammonia, and if certain ingredients are present in excess, this action will go on for weeks, a slow precipitation of organic matter taking place at the same time. I found very early in my experiments on the subject that an ammonia determination in the effluent water was valueless, unless made within two or three hours; all but about ten of mine were so made at Leicester.

If Dr. Frankland's samples were not analysed for some days the explanation is clear. I may add that this action being gradual does not sensibly affect the suspended matter, but acts only on the dissolved impurities. Its effect must, I consider, be beneficial in enabling the remaining nitrogen to be more readily assimilated by the plants in the rivers. The A.B.C. process does, therefore, remove the larger part of the ammonia, although it subsequently produces a further quantity in the water, and a corroboration is found in the fact that, although the new process produces a much larger quantity of residue than the lime process, the percentage of ammonia in the residue is more than twice that in the lime.

Dr. Frankland expresses a doubt which I can easily remove as to the source of the phosphoric acid in the manure. During the whole experiments (10,000,000 gallons) 143 lbs. of phosphoric acid were used in the form of bone black. The actual quantity of manure made is not less than 80 tons at the lowest estimate (for all is not yet dry enough to weigh). 143 lbs. of phosphoric acid will be ·080 per cent on this quantity, leaving 416 per cent as the quantity derived from the sewage.

I have noticed no points but Dr. Frankland's own figures and statements. The process will be at work in a few weeks on a large scale with works specially adapted for it, and capable of treating about 1,000,000 gallons per day. The real proof of the capabilities of the process will be in these works.—I am, &c.,

G. W. Wigner.

Camberwell, Nov. 16, 1868.

MISCELLANEOUS.

Cohesion Figures.—We have received from Dr. R. Carter Moffat some specimens of cohesion figures of rape oil on water, fixed on paper in colours by a new process. Our correspondent is now working out the subject, and promises further particulars shortly.

British Sea-weed Charcoal.—This preparation, which has been patented by the British Sea-weed Company, is found to be a good substitute for animal charcoal, as a filtering medium for water, deodorising sewage, clearing white glass, removing acidity from and decolourising wines and spirits, and precipitating and decolourising vegetable alkaloids. It is manufactured from the fine tangle of the Hebrides.

The Quarterly Journal of Microscopical Science.—We are requested by the publishers of the above journal to state that that journal will continue to be published as usual by the Messrs. Churchill, and edited by Dr. Lankester and Mr. E. Ray Lankester. The only change consequent upon Dr. Lankester and Professor Busk ceasing to edit the "Transactions of the Royal Microscopical Society," will be that the Transactions of that Society will not be published separately in the pages of the journal.

Advertisements and Certificates.—Some correspondence in a morning contemporary reminds us that the public seldom take the trouble to distinguish between advertisements when the notices include a chemical certificate. A tradesman anxious to inform the world that he has for sale some particular article of general consumption proceeds to advertise the same. So far good. If a shopkeeper can supply bread, beer, wine, sauce, pickles, pills, cocoa, cod liver oil, or other article of food or medicine, better and cheaper than housekeepers have hitherto been able to obtain it, let him by all means say so in any ordinary way he pleases. Further, if a manufacturer desire to strengthen his own statements as to the merits of his goods, there can be no objection to his employment of an analyst and the publication of the chemist's report in newspapers, circulars, and labels. Nor is the public to blame for accepting the statements of well-known Professors of Chemistry, nor the latter for giving such statements, concerning the purity or quality of those liquid and solid substances which cannot, like a bottle of blacking or a joint of meat, be appraised by effects or appearances. But buyers are wrong in forgetting that the certificate of a chemist only applies to the particular sample analysed; vendors are wrong in wrapping this certificate round every package they sell, and those chemists are wrong who word certificates in such a general way as to admit of readers being misled. An analyst's report should pointedly refer to the single specimen examined, and, when used in an advertisement, should be accompanied by a declaration on the part of the manufacturer that every parcel sold is of equal quality to that analysed. It is, perhaps, only right to say that leading chemists demand these, or similar conditions, before consenting to allow their names to be cited for trade purposes, and many, in view of the abuse on which we are commenting, refuse such certificates altogether. Without some such precaution the publication of chemical certificates relating to articles of food, drink, or medicine, or the statement that certain goods are "highly spoken of by the medical press," or "recommended by the faculty," whatever that may mean, avail nothing.—*Express.*

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Comptes Rendus.
August 31, 1868.

Peligot, "On the Preparation of Uranium." B. Tollens, "On the Oxidation of Phenol." Gayard, "A Method of Preventing the Explosion of Fire-damp in Coal Mines." A. Bechamp, "On the Spontaneous Alcoholic and Acetic Fermentation of Eggs." W. Evans, "Researches on the Use of Protoxide of Nitrogen as an Anæsthetic." Delaurier, "Note on a new Exciting Liquid for Voltaic Batteries." Redslob, "On a new 'Volta-Faradayic' Apparatus."

September 7, 1868.

A. W. Hofmann, "Note on Menaphthylamine." A. Bechamp, "On the Caproic and Caprylic Fermentation of Ethylic Alcohol. On the Formation of Caproic Alcohol during the Caproic Fermentation of Common Alcohol."

September 14, 1868.

De Lapparent, "Report on Pasteur's Method of Preserving Wine by means of Heat."

September 21, 1868.

Dumas, "Remarks on Affinity." Chevreul, "Remarks on the same Subject." L. L'Hote and Saint-Edme, "On the Production of Ozone in Oxygen and Air under the Influence of the Electric Spark from Ladd's Condenser."

September 28, 1868.

Chevreul, "On Chemical Affinity." J. Lemaire, "Are Typhus, Cholera, Yellow Fever, Dysentery, Intermittent Fevers, and Hospital Gangrene to be attributed to Infusorial Ferments?" V. de Luynes, "On some new Combinations of Orcine." A. Scheurer-Kestner and C. Meunier, "Researches on the Combustion of Coal (Second part). F. Pisani, "Analysis of a Meteorite which fell at Ornans, Doubs, on July 11, 1868."

Bulletin de la Société Chimique de Paris.
September—October, 1868.

P. Schutzenberger, "Memoir on the Colouring Matters extracted from the Seeds of Persian Berries. Memoir on some Reactions producing Oxychloride of Carbon, and on a new Volatile Compound of Platinum." A. Rosenstiehl, "On the Presence of an Alkaloid Isomeric with Toluidine in Commercial Aniline. E. Bourgoin, "On the Part taken by Water in Electrolysis. Note on the Electrolysis of Benzoic Acid." H. Baubigny, "On some Derivatives of Camphor." P. de Clermont, "On a new Alcohol Isomeric with Octylic Alcohol." A. Opponheim and G. Vogt, "A new Method of preparing Resorcine." Bechi, "Analysis of the Leaves of the Mulberry Tree." F. Sestini, "On some Properties of Liquid Sulphurous Anhydride."

Dingler's *Polytechnisches Journal.*
August, 1868.

A. Christomanos, "A new Method of Assaying Silver by means of Oxygen Gas" "Note on A. Prandtl's Researches on the Preparation of Extract of Milk."

Monatsbericht der Königlich Preussischen Akademie der Wissenschaften zu Berlin.
May, 1868.

Ehrenberg, "On the alleged Use of Red Earth as Food by the Inhabitants of Guinea." Magnus, "On the Diathemancy of Sylvine."

Poggendorff's *Annalen der Physik.*
No. 8, 1868.

C. Rammelsberg, "On Periodic Acid and its Salts. On the Crystalline Form and Optical Properties of Periodic Acid." G.

Jenzsch, "On the Laws of the Formation of Twin Crystals of Quartz."

Annales de Chimie et de Physique.

August, 1868.

E. Bourgoin, "On the Electrolysis of Malic Acid."

Annalen der Chemie und Pharmacie.

Vol. 6., No. 2.

H. Landolt, "Researches on the Elasticity or the Vapours of Homologous Compounds." R. Bunsen, "On the Calculation of Compound Felspars." A. Naumann, "On the Dissociation of Hyponitric Acid." W. Lossen, "On the Action of Tin and Hydrochloric Acid on Nitric Ether." A. Staecker, "Note on H. Schiff's Hydracetamide."

Journal fur Praktische Chemie.

August, 1868.

Buchner, "On the Composition of Blood when Poisoned by Prussic Acid," C. Heintzel, "New Researches on Triamidophenol."

September, 1868.

F. Rochleder, "On the Composition of the Leaf of the Horse Chesnut Tree. On Æsculine and Æsculetine. On the Capsules of the Fruit of the Horse Chesnut Tree. On Isophloridzine." M. Jaffe, "Contributions to the Knowledge of the Colouring Matters of Bile and Urine." R. L. Maly, "On some new Derivatives of Thiosinamine." M. Delafontaine, "On some new and little known Molybdates, and on the principal Fluoxymolybdates." C. Mariqnac, "On the Reduction of Niobium and Tantalum Compounds." H. Baumhauer, "On the Causes of the Solidification of Supersaturated Saline Solutions." G. vom Rath, "On a new Crystalline Modification of Silicic Acid." Igelström, "Analyses of Epiphanite, Damourite and Pyropyhllite from Sweden." F. Stolba, "On the Action of Sulphur on Sulphate of Iron." A. Bauer and E. Klein, "Note on the Action of Tetra-chloride of Tin on Amylic Alcohol." E. Brucke, "On the Detection of Ammonia in Animal Fluids, and on the Behaviour of the same in some of its Compounds."

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3036. R. Heilmann, and P. Hart, Manchester, "An improved method of utilising the fumes or vapours evolved during certain chemical operations."—Petition recorded October 5, 1868.

3086. J. Dewar, M.D., Kirkcaldy, Fifeshire, N.B., "Improvements in preparing food from the entrails of animals."—October 8, 1868.

3101. H. A. Archereau, Boulevart St. Martin, Paris, "A new method of obtaining heat and light and its various applications, and in apparatus connected therewith."—October 9, 1868.

3138. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved mode of, and means for, dyeing hair."—A communication from W. Patton, Springfield, Mass., U.S.A.—October 13, 1868.

3149. W. Lorberg, Brunswick Place, City Road, Middlesex, "An improved process of treating cotton seed, and utilising the refuse resulting therefrom."—October 14, 1868.

3177. E. T. Hughes, Chancery Lane, "An improved adhesive substance."—A communication from J. and A. Tolin, Montreuil, France."—October 17, 1868.

2598. A. Rollason, Pembroke Road, Clifton, Bristol, "Improvements in purifying coal-gas and obtaining ammonia from coal-gas products."—Petition recorded August 20, 1868.

3118. F. W. Hart, Kingsland Green, Middlesex, "A new (or improved) material or substance to be used for varnishing or protecting the surfaces of lithographs, photo-lithographs, and other like printed surfaces."—October 10, 1868.

3194. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved method of preparing, desiccating, and preserving fish."—A communication from W. D. Cutler, Philadelphia, Penn., U.S.A.—October 19, 1868.

3206. J. Sykes and G. Malin, High Holborn, Middlesex, "An improved composition to be used for 'filling up' the bodies of carriages and other substances previous to receiving the colouring matter."—October 20, 1868.

3250. J. Spratt, High Holborn, Middlesex, "Improved preparations of food for horses, cattle, game, poultry, and other domestic animals, such preparations being capable of admixture with compounds for the production of a medicated food for man."

3256. A. Girand, Gray's Inn Road, Middlesex, "Improvements in separating silver from argentiferous lead, in purifying lead, and in apparatus for the same."—October 24, 1868.

3267. P. M. Crane, Manchester, "An improved compound or size to be used in sizing and dressing cotton yarns or cotton warps."—October 26, 1868.

3285. J. Little, Glasgow, N.B., "Improvements in glass furnaces."—October 27, 1868.

NOTICES TO PROCEED.

3033. B. E. R. Newlands, Charlton, Kent, "Improvements in the manufacture of manure, and in the production of salts of ammonia." October 3, 1868.

2034. J. Mitchell, Bradford, Yorkshire, "Improvements in furnaces."—Petition recorded June 24, 1868.

2061. L. Thomas, Leadenhall Street, London, "A new or improved apparatus to be used along shore for the distillation of pure water from salt water, or impregnated with earthy or other matters."—June 25, 1868.

2078. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved mode of, and apparatus for, dyeing textile fabrics and yarns."—A communication from L. Gouchon, Lisieux, France."—June 27, 1868.

3112. T. Merz, Hebburn, and G. Thomson, Pelaw-Main, Durham, "Improvements in calcining ores, minerals, and other substances, and in furnaces therefor."—October 10, 1868.

2134. A. Fryer, Manchester, "Improvements in the concentration and treatment of saccharine and saline solutions, and in apparatus employed therein."—Petition recorded July 4, 1868.

2144. A. Fryer, Manchester, "Improvements in the mode of treating, for evaporating and concentrating purposes, cane juice, beet-root juice, and other saccharine and other solutions and liquids, and in the construction of apparatus for the concentration of saccharine and other solutions, and for the evaporation of liquids."—July 6, 1868.

2152. E. Coppée, Haine St. Pierre, Belgium, "Improvements in the construction of coke furnaces."—July 7, 1868.

2375. E. Herring, Beer Lane, London, "Improvements in the treatment of saccharine solutions of malt or sugar."—July 29, 1868.

NOTES AND QUERIES.

Salamander would be glad to know what is the best coating to render wood fire-proof?

Rock Phosphate.—If your correspondent would communicate with Otto Christopher, Esq., Runkel on the Lahn, near Limberg on the Lahn, Nassau, Prussia, he will meet with the opportunity of obtaining the information he desires.

Estimation of Free Hydrochloric Acid.—Will you allow me to correct an error which occurs in my letter of the 7th inst., "On the Estimation of Free Hydrochloric Acid"—the word "sulphates" should be omitted.—John T. Hobson.

Drying Oils.—I would be much obliged if any of your correspondents would assist me in this:—I desire to render unboiled linseed oil a drying oil, without heating at all. I have tried the plumbic acetate process of Liebig, and the manganic borate mentioned in Ure, but have failed. I know there is a process by which unboiled linseed oil can be made to dry quickly (within 24 hours), but I have completely forgotten regarding it. Perhaps Dr. Adriani, or some other of your well-informed contributors would kindly oblige?—Waterproof.

Bichromate of Ammonia.—Not the least valuable feature in the Chemical News is the columns devoted to Notes and Queries and Answers to Correspondents. Many valuable items have I obtained thence, and I am glad to see that this column is open to American readers, and I gladly avail myself of this privilege to enquire if any of the readers of the Chemical News can inform me of a cheap mode of making bichromate of ammonia. Can it be made from the bichromate of potash? If so, by what process? Any information on this point will be gratefully received by Tyar, Louisville, Ky.

Determination of Acetic Acid in Commercial Acetate of Lime.—The best method of ascertaining the percentage of acetic acid in commercial acetate of lime is, according to Fresenius, the following:—Put 5 grammes of the substance in a retort, add 50 c.c. of water and 50 c.c. of phosphoric acid, sp. gr. 1·2 (free from nitric acid); distil with caution to dryness, and repeat the operation, after adding again 50 c.c. of water, twice. Unite the distilled liquids, and dilute to 250 c.c. In 50 or 100 c.c. determine the acetic acid with a standard alkaline solution. It is necessary to test the distilled liquids for hydrochloric acid, and if found in considerable quantity, to determine it with a standard silver solution. For particulars, see Fresenius's *Journal for Analytical Chemistry*, vol. v., p. 315.—V. C.

TO CORRESPONDENTS.

J. W. S.—You will be able to get what you require at Ladd and Oertling's.

V. C.—Received, with thanks.

W. H. Walenn.—If our correspondent would favour us with a short account of his theorem, illustrating its applicability for checking chemical and other calculations, it would be a boon which would be highly appreciated by many of our readers.

R. Coulthard.—Mulder's book on "Beer" is the best; but we do not think it has been translated into English. We do not know of one in this language.

Communications have been received from Dr. R. Angus Smith, F.R.S.; C. Turner; Messrs. Churchill and Sons; R. Coulthard; W. H. Walenn (with enclosure); E. C. C. Stanford (with enclosure); G. W. Wigner; Dr. S. Muspratt; S. Mellor; E. Jones; A. Martinelli; J. T. Hobson; V. Cruse; J. Samuelson; T. Hobbs; A. P. Hurlstone; J. Cliff; W. H. Perkin, F.R.S; F. Sutton; W. M. Watts; F. C. Macdonnell; E. P. Potter; F. C. Calvert and Co. (with enclosure); Brooke, Simpson, and Spiller; Watson Smith (with enclosure); J. Primrose; J. Hulle; Dr. R. Carter Moffatt; and S. Meunier.

THE CHEMICAL NEWS.

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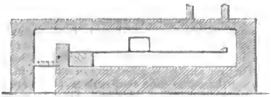
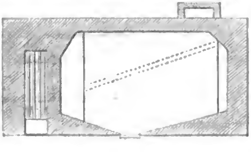
ON THE PURIFICATION OF TIN ORES FROM WOLFRAM.

By ROBERT OXLAND, F.C.S.

Tin ores are rarely found associated with wolfram, but when this association does occur, the proportion of wolfram is frequently very large. It cannot be separated from the tin oxide by the ordinary processes of calcination and washing in water, because it is not affected by heat alone, and its specific gravity being greater than that of the tin ore it remains mixed with it in spite of all washing. It can be separated by digestion in muriatic acid without any very great difficulty, but it is done more easily by the agency of soda ash, the crude carbonate of soda, or by salt cake, the crude sulphate of soda. The proportion of wolfram associated with the tin ore having been determined by analysis, soda ash is mixed with the dry ore in such quantity as to supply an equivalent of soda for the tungstic acid present. The mixture is calcined at a dull red heat in a reverberatory furnace, of which a longitudinal section and a plan at the level of the working bed is shown in the annexed sketches:—





In the plan, the dotted lines show the form and direction of the flues beneath the cast-iron bed, over which the fire passes from the fire place on to the back bridge and down into the flues under the bed, and thence away to the chimney. The use of the cast-iron bed is all-important in order to prevent the combination of the soda with silica and with tin. With proper management a charge of 10 cwts. of tin ore can be worked off in four hours, so that 3 tons of ore per diem may be operated on with a consumption of less than 10 cwts. of coal.

The object of the process is to cause the decomposition of the wolfram by making the tungstic acid combine with the soda, at the same time to convert the basic protoxides of iron and manganese into peroxides, for the purpose of rendering them as light as possible to facilitate their subsequent separation by mechanical washing. This calcining operation is therefore essentially an oxidising one, and the fire should be worked accordingly. The charge drawn from the furnace should not cake. While hot it is thrown into one of a series of lixiviating cisterns partially filled with water, which is thereby rendered boiling hot. After standing a short time the liquor is run slowly off from the bottom of the vat bright and clear, and if of sufficient strength is set aside to crystallise, otherwise it is boiled up to strength before it is put into the crystallisers. The weaker liquors are used instead of water for lixiviating fresh charges of the calcined ore. Traces only of stannate of soda are to be found in the liquor if the operation be properly conducted.

Salt cake may be advantageously employed when skilled labour is obtainable; it is mixed with the ore in proportions indicated by the quantity of wolfram present. A quantity of coal dust slightly in excess of the quantity necessary for the deoxidation of the sulphuric acid of the salt cake, is mixed with the charge, and the whole is exposed until red hot in the furnace to the deoxidising flame. After this a clear fire and an oxidising flame are maintained until the tungstic acid has, by combination with the sodium, driven off the remainder of the sulphur. The charge takes about an hour longer in the furnace than is necessary for the soda ash mixture.

The charge drawn from the furnace is lixiviated in the same manner as before, and after all the soluble matter has been removed, the remainder of the charge is thrown out from the vats and subjected to a series of washing operations without any stamping, but occasionally with a small amount of scrubbing, whereby the peroxides of iron and manganese are washed off. The last traces of these oxides may be removed by digestion for a few hours in muriatic acid, leaving the binoxide of tin, or black tin of the Cornish miner, nearly pure, capable of producing, by smelting, the finest quality of metallic tin.

CHEMICAL APPARATUS.

By W. P. DEXTER

Gas Lamps for the Ignition of Crucibles, &c.—The ordinary Bunsen burner is known to act upon the surface of platinum vessels brought into contact with the inner line of the flame; the metal loses its polish, becoming superficially porous and spongy, and requires the use of the burnisher to bring it back to its original state. This alteration of the surface I have found to be attended with a change of weight, so that for some years I have used a lamp of different construction for the heating of platinum crucibles in analytical operations. Such a lamp may be made by removing the air tube of a common Bunsen lamp and putting in its place a somewhat longer one of glass or iron of about 12 millimetres internal diameter. The gas jet should have a single circular aperture, and be in proper proportion to the diameter of the tube, which may be held in any of the ordinary clamp supports. The tube being raised sufficiently above the jet to allow free entrance of air, and a full stream of gas let on, a "roaring" flame is produced, of which the interior blue cone is pointed, sharply defined, and extends only about half an inch from the top of the tube. A polished platinum surface is not acted upon by this flame provided it be not brought into contact with the interior cone. In the Bunsen burner, as usually made, the supply of air depends upon the diameter of the tube, the holes at its base being more than sufficient to supply the draught. With the wider tube it is necessary to limit the admission of air by depressing the tube upon the lamp when the force of the gas is diminished. Otherwise the proportion becomes such that an explosive mixture is formed; for this reason it is more convenient to use an arrangement in which the access of air can be regulated by an exterior tube sliding obliquely downward over the air apertures. The gas jet should be on a level with the top of these apertures, which must be much larger than those of the ordinary Bunsen's burner.

On account of the liability to explode and burn at the jet inside, the lamp is not well adapted for ordinary use; but for ignition of crucibles, working of glass, &c., it has proved efficient and practical.

Gas Regulator.—Now that gas is universally used as a source of heat in laboratories, it is desirable to have a means of keeping the pressure constant, and independent of the changes which take place in the mains. By the regulator of Kemp a uniform temperature can be kept up for any length of time; but this apparatus is a little difficult to adjust, is not universally applicable, and can be used in but one operation at a time. By regulating the pressure of the gas, on the other hand, a constant supply of heat is furnished, but the temperature is not so exactly maintained in consequence of the more or less rapid abstraction of heat by change of temperature of the locality, and from currents of air. It is, however, as constant as it can be kept by a spirit lamp, which we are at present often obliged, from the variations of pressure, to substitute for gas; while the regulator may be connected with several burners, or even include the whole laboratory, if the gas pipes are of sufficient size.

The arrangement which I have had in use for the last year consists of a common gasometer, made of zinc, and about 9 inches in height and diameter. The floating bell is connected by a jointed rod with a stopcock in the pipe by which the gas enters. When the bell rises from the pressure of the gas, it gradually closes this cock, and thus cuts off the further supply. The gas is then under a constant pressure depending upon the weight of the bell; as gas is consumed the bell sinks and opening the cock allows more to flow in. The difference of weight of the bell from its greater or less immersion in the water is inappreciable; a very slight diminution of pressure, hardly perceptible without a microscope, is observed when one of the outlets is suddenly thrown open to its full extent, and is due, probably, to the friction of the gas in the tubes, which should therefore be of considerable size.

The apparatus should not be painted, as oil is acted upon by water, which has been long in contact with gas. Asphaltum varnish seems to answer better.—*American Journal of Science*, July, 1868.

RESEARCHES ON

THE ESTIMATION OF PHOSPHORUS CONTAINED IN CAST-IRON.

By M. V. TANTIN.

It is well known that the presence of a very small quantity of phosphorus in cast-iron does not produce any sensible modification in its properties; it nevertheless loses its most essential qualities when the proportion of contained metalloid amounts to some thousandths; the importance of ascertaining the exact proportions of phosphorus in cast-iron is, therefore, self-evident. Almost all the methods hitherto proposed consist in treating cast-iron with oxidising agents in such a manner as to cause the phosphorus to pass into the condition of phosphoric acid, which is deposited as a magnesian compound; several sources of error are inherent to this method for the following reasons:—

1st. Part of the phosphorus escapes the action of the oxidising agents, and evolves as a hydrogenised compound.

2nd. It is necessary to work upon very dilute liquids in order to avoid an admixture of oxide of iron with the ammoniaco-magnesian phosphate; under these conditions it is difficult to collect the small quantity of phosphate disseminated upon the sides of the vessel in which the precipitation takes place.

3rd. Any arsenic which may be contained in the cast-iron will be discovered in the precipitate as an arseniate, whose insolubility is equal to that of the phosphate.

When seeking the means of avoiding these sources of error, I concluded that the best way of so doing would be to use a precisely contrary method, namely, by liberating the phosphorus as an hydrogen compound; but one objection naturally arose—would the totality of the phosphorus pass into the state of a gaseous product? I may safely affirm that I have never been able to discover the least trace of phosphorus in the residue after the complete attack of the cast-iron by chlorhydric acid, which fact is not surprising if it be considered what strong affinities phosphorus has to hydrogen. The phosphide of hydrogen produced by the action of chlorhydric acid upon cast-iron is almost always accompanied by sulphuretted, arseniated, and carburetted hydrogen. In order to effect the separation of these gases I first pass them into a Woulff's flask containing a solution of potash, which absorbs the sulphuretted hydrogen; the other gases are then made to traverse a solution of nitrate of silver, which transforms the arseniated hydrogen into arsenite of silver soluble in the liquid, which has become slightly acid, whilst the phosphuretted hydrogen precipitates the silver solution and forms an insoluble phosphide. The phosphorus being thus completely separated from the sulphur and arsenic, its estimation is effected in the simplest manner, the phosphide of silver is treated with aqua regia, and thus transformed into chloride of silver and phosphoric acid, which is precipitated in the state of ammoniaco-magnesian phosphate; this precipitate when calcined gives a weight which serves to calculate the proportion of phospborus. To ascertain the amount of phosphorus contained in cast-iron, the following precautions are indispensable.

1st. The cast-iron must be attacked very slowly, or part of the phosphuretted hydrogen may traverse the solution of nitrate of silver without being absorbed.

2nd. When the attack of the cast-iron is finished, a current of hydrogen, previously washed in acetate of lead, must be passed through the trough.

The solution of potash will contain all the sulphur in the matter under analysis; if this body is to be estimated, the solution must be treated with acetate of lead. The precipitate first formed is a mixture of oxide and sulphide of lead, but the oxide soon re-dissolves, and there remains only the sulphide, PbS. This precipitate is collected on a tarred filter, washed with distilled water, completely dried at 100°, and weighed.—*Comptes Rendus*,

MILDEW IN COTTON GOODS.

Mr. J. C. Lee has sent a communication to the *Manchester Guardian* on the above subject, of which the following is a condensed account:—

It appears to me that only a few means are requisite to almost, if not completely, prevent mildew in cotton goods on shipboard. In the first place the size should be perfectly fresh—that is, not made from mouldy flour, nor permitted to become either mouldy or sour before use. This is absolutely necessary to prevent the formation or deposit of the spores or germs of mildew. It should also be free from extraneous mineral matters, and especially deliquescent substances, which, however good the size may be in other respects, would attract moisture, and thereby contribute the only requisite (all others being present) for the development of fungi or mildew. In the second place, the compartment of the vessel in which the goods are stored should be well ventilated and heated.

Shippers can, I believe, obtain from the seller a guarantee of the purity of the size. If not, however, they have an easy remedy in their own hands. Any analytical chemist can with facility in comparison with an equal weight of a standard piece of cloth determine the purity of another piece. This can be done in a simple and almost mathematically correct manner, and, therefore, reliably for commercial purposes, by thoroughly drying say 50 grains of the cloth, and noting the loss in weight, that is moisture, then igniting, and weighing the ash. Indeed, for all practical purposes, merely igniting, weighing the ash, and comparing its weight with that of the standard would be sufficient. The increase over the standard multiplied by two would give the percentage of mineral adulteration of the size. It is true there are certain salts, as chloride and sulphate of ammonium, &c., which, being volatile, would be driven off by ignition, and would not, therefore, be found in the ash. But they are too expensive to add to size, and their presence being easily recognised would in my opinion preclude the possibility of their admixture. With respect to ventilation and heating, the former requires at most a little mechanical contrivance suitable to the position of the goods or construction of the vessel. Heating could be effected by means of pipes. Manufacturers would be very glad to adopt any safe and reliable guide to assist them in the purchase of flour, but very few of these gentlemen are chemists, and hence thay are liable to deception. I am persuaded they are too often blamed for using bad size, when they have done their best to procure the best quality of flour. I beg to suggest for their use also the test I have proposed for yarn and cloth—comparison to be made as before with the ash of say 50 grains of any sample and the ash of 50 grains of a standard quality of flour. The difference in weight multiplied by two will give the percentage of admixture. If it would not be considered too tedious it would be well to shake up a couple of ounces of the flour with a pint of water, leave it to settle ten minutes, and dip into the solution a leaf from a litmus book, or decant the fluid and shake it a few minutes with a few drops of tincture of litmus, and compare the result with that of a similar experiment on a model or standard sample. It is needless to say anything of the importance of the colour and smell of flour. I almost forgot to state that if ¼lb. of yarn or cloth were worked a few minutes in just sufficient cold water to cover either, left to steep half an hour, then wrung out, and a three or four ounce white glass bottle of the solution shaken up three minutes with a few drops of tincture of litmus, in case of an impure or mouldy size having been used, the reaction would be very different from that resulting from similar treatment of yarn or cloth to which pure size was applied.

Within the last few days I have, on inquiry, been informed by manufacturers that magnesium sulphate or Epsom salt is regularly sold for size admixture. I have also been apprised, on credible authority, that 150 tons of this substance are disposed of weekly in Manchester for this purpose alone. This is a ponderous quantity, and its statement will, I think, be advantageous to those who are financially interested in the matter. Commercial magnesium sulphate, moreover, contains 51·21 per cent of water, while, owing to its contamination with foreign salts, it is deliquescent, or attracts moisture from the atmosphere, without which fungi or mildew cannot exist. There are mineral substances that can be adopted with safety, and if size adulteration must prevail they should at once, at least for India goods, be substituted for Epsom salt.

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Continued from page 245.)

Constructions of Dietaries: Preparation and Culinary Treatment of Foods.

In the treatment of animal food there are several points for consideration. In the first place it is always best to prepare the animal for the shambles by fasting it for a few hours before it is slaughtered, as partially digested food, and the food recently absorbed into the system, quickly pass into a state of putrefactive decomposition and taint the whole carcass; besides which, a day's repose is often necessary to quell the excitement occasioned by the journey or voyage which the animal may have made on its way to the place of slaughter. In the second place, it is proper to remove as much blood from the body as possible at the time of killing, as this also is apt to pass into a state of decay. The regulations of the Jews in this particular are most effectual, and are derived from very ancient statutes in Leviticus, which ordain that no manner of blood, whether it be of fowl or of beast, shall be eaten by man; and with the view of letting as much of it flow away as possible, the practice is to slaughter every animal by cutting its throat with a sharp knife. There are, indeed, the most precise rules for this purpose. In some countries, however, the blood is regarded as a very nutritious part of the animal, and great pains are taken to prevent its escape. Dr. Livingstone says, that many of the South-African tribes kill the beast by thrusting a javelin into the heart, so as to prevent the loss of blood. But in these cases the meat is never kept, but is eaten directly after the animal is slaughtered. A proposition has also been made in this country for killing animals by letting air into the pleural cavities, whereby the lungs collapse, and so cause almost instant death by asphyxia without loss of blood; but the practice is objectionable, not merely because of the liability of such meat to quick putrefaction, but also because of the difficulty of discovering disease in it.

In the third place, it is proper that the carcass of the animal should be allowed to cool and set thoroughly, before it is packed for conveyance to the market. If this is not properly attended to it soon decays. It should also be packed loosely, or even freely exposed to the air, as the colouring matter of the blood and muscles continue to absorb oxygen, and to breathe, as it were, for some time after death, and while this goes on decay is arrested.

Lastly, all meat should be kept a little short of decomposition before it is cooked, or even until decomposition has just commenced, as the tissue then becomes loose and tender, and very digestible.

In the culinary treatment of animal food, the objects are fourfold:—

1st. To coagulate the albumen and blood of the tissues, so as to render the meat agreeable to the sight.

2nd. To develop flavours, and to make the tissue crisp, as well as tender, and therefore more easy of mastication and digestion.

3rd. To secure a certain temperature, and thus to be a means of conveying warmth to the system.

4th. To kill parasites in the tissues of the meat.

Now, as the researches of Dr. Beaumont and others have demonstrated that meat is always rendered more and more indigestible in proportion to the prolonged action of heat, it is highly necessary that the temperature should not be continued beyond the point necessary to accomplish these objects. Liebig says that a temperature of 133° Fahr. will coagulate albumen, and that the red colouring matters of the blood and muscle are coagulated and destroyed at from 158° to 165° (say 170°). He therefore advises that all cooking operations, in respect of meat, should be limited to 170°. His directions are that, in boiling meat it should be introduced into the vessel when the water is in a state of brisk ebullition, and that the boiling should be kept up for a few minutes. The pot is then to be placed in a warm situation, so that the water is maintained at from 158° to 165°. The effect of this is that the boiling water coagulates the albumen and tissue upon the surface of the meat, and to a certain depth inwards, and thus forms a crust which does not permit the juice of the meat to flow out, nor the water to penetrate into the meat. The flesh, therefore, retains its savoury constituents, and is not too sodden; but if, on the other hand, the meat be set upon the fire with cold water, and then slowly heated to boiling, the flesh undergoes a loss of soluble and savoury matters, while the soup becomes richer in them. The albumen, in fact, is gradually dissolved from the surface to the centre; the fibre loses, more or less, its quality of shortness or tenderness, and becomes hard and tough. The thinner the piece of flesh is, the greater is its loss of savoury constituents.

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* The Cantor Lectures, delivered before the Society of Arts.

This explains the well-known observation that that mode of boiling which yields the best soup gives the driest, toughest, and most vapid meat; and that, in order to obtain well-flavoured and eatable meat, we must relinquish the idea of making good soup from it.

If finely-chopped flesh be slowly heated to boiling with an equal weight of water, and be kept boiling for a few minutes, then strained and pressed, we obtain the very strongest and best flavoured soup which can be made from flesh. When the boiling is longer continued, some little additional organic matter is dissolved, hut the flavour and other properties of the soup are thereby in no degree increased or improved. By the action of the heat on the fibres of meat, a certain amount of water or juice is always expelled from them; whence it happens that the flesh loses weight by boiling, even when immersed in water (as much sometimes as 24 per cent of the weight of raw flesh). In larger masses this loss is not so great.

Even in roasting meat the heat must be strongest at first, and it may then be much reduced. The juice which, as in boiling, flows out, evaporates, in careful roasting, from the surface of the meat, and gives to it the dark brown colour, the lustre, and the strong aromatic taste of roast meat. It is doubtful, however, whether the heat of 170° is sufficiently high to ensure the destruction of the parasites of meat, and therefore I would advise that the temperature should be as nearly as possible to that of boiling water (212°).

Of the four methods of cooking which are commonly practised in this country—viz., boiling, baking, roasting, and frying, the former is undoubtedly the most economical, and produces the most digestible food, but the flavour of the meat is not well developed, and it is quite unsuited for many descriptions of meat; the flesh of young animals, for example, consisting of an undue proportion of albumen and gelatine in the tissues, will boil away to a large extent, and so will lose fatty tissue, like that of American bacon; and, indeed, unless the process is well managed, there will always be considerable loss, as I have just stated, from the escape of albumen, saline matter, and the alkaloids of the meat, into the water, amounting sometimes to from 16 to 24 per cent of the weight of the joint; and that these are valuable constituents of flesh is proved by the experiments of the French Academicians, who found that when a dog was fed daily upon half a pound of boiled flesh which had been previously soaked in water and pressed, it quickly lost weight—as much, indeed, as one-fourth of its entire weight in forty-three days; and in fifty-five days the emaciation was extreme. Of course these observations do not apply when the liquor in which the meat is boiled is eaten with it, as in the case of hashes, stews, &c.

Dr. Pereira states that, at the Wapping Workhouse, where mutton (chiefly fore-quarters) and beef (consisting of the brisket, thick and thin flanks, leg of mutton pieces, and clods—all free from bone) were boiled, the average loss in weight was only about 17½ per cent; but this is under the common proportion, and shows that the meat was from old and lean animals. The ordinary loss of weight in cooking is about as follows in every 100 parts:—

	Boiling.	Baking.	Roasting.
Beef generally	20	29	31
Mutton generally	20	31	35
Legs of mutton	20	32	33
Shoulders of mutton ..	24	32	34
Loins of mutton	30	33	36
Necks of ditto	25	32	34
Average of all ..	23	31	34

But, although the loss of weight in baking and roasting is greater than in boiling, yet it is chiefly from evaporation and from the melting of the fat. Flavours also are developed which give a pleasant relish to the meat; but there are many disadvantages to these methods of cooking, as that the surface of the joint is often overdone when the interior is almost raw; and that the action of the heat on the superficial fat frequently produces acrid compounds (consisting of acrolein and fatty acids) which are very distressing to a sensitive stomach. This is always the case when meat is fried or grilled, and is thus subjected to a temperature of 600° or more; in fact, all baked and roasted fatty foods are apt, on this account, to disagree with delicate stomachs; and it is often remarked that, although bread and butter, boiled puddings, boiled fish, or boiled poultry can be eaten freely without discomfort, yet toast and butter, or meat pies and pastry, or fried fish, or roasted fowl, will disagree with the stomach. The practice of covering poultry and game with lard, or oiled paper, or thin dough, or even with clay (feathers and all, as is the Indian custom), and then roasting, is no doubt advantageous, as it modifies the temperature and prevents the formation of acrid fatty compounds. It was by some such device as this that Aristoxenes was able to serve up a pig apparently boiled on one side and roasted on the other—the savoury crackling being suited for stronger stomachs, while the more delicate side of it was best adapted for weaker digestions.

In deciding, however, on the proper method of cooking a joint, regard must always be had for the kind of flavour that is to be developed. Shoulders of mutton and fresh beef are rarely boiled, because of their insipidity. The same is the case with game and poultry, for the barndoor fowl and turkey are nearly the only examples of the latter which can be boiled, and there are no such examples among the former. What should we think of a boiled pheasant? A story is told by a writer in the *Society's Journal*, of a poacher who wished to seduce a bumpkin new poacher by a practical illustration of the fine flavour of game, and calling at his cottage one day, he left for him a hare, warm from the chase, telling him to cook it, and to try if it warn't a nice dinner for nothing. A week after he called again, and asked him how he liked his dinner. "Didn't loike it at all," exclaimed the recipient. "Well, man," says the poacher, "how did e cook en?" "Why, biled en in tarmuts, to be zure." I won't attempt to describe the disgust of the poacher. The same is the case with venison, although it may be boiled, especially when it is rather high, for about half the time necessary for cooking it, yet it must be roasted, in order to develope its flavour. Hunters in the wild prairies of America are accustomed to cook the flesh of the deer by brittling it in the following manner:—They strip off the long muscles from each side of the spine, both above and below, and tie them up in a roll, after well smearing them with oil or fat; they then roast them, and baste them perseveringly with oil. If opportunity permits, they sprinkle them with lemon juice, before they are oiled and made up into a roll. The flavour of roasted meat and its grateful effect on the sense of smell must have been recognised in very early times, for burnt offerings are frequently spoken of by Moses as "a sweet savour unto the Lord," and particular accounts are given of the manner in which these offerings of the lamb and the kid, &c., were to be made acceptable, not merely to the Lord, but also to Aaron and his sons, who were to eat of them. How far back in history the flavour of roast pig was eulogised I know not, but it is immortalised in the essay of Charles Lamb. As for the process of baking meat, it is not nearly so refined as that of roasting, although it has one advantage, in the circumstance that the temperature can be more easily regulated than with roasting.

In making soup, the object is to extract, as completely as possible, all the soluble constituents of the meat or bone, and when the latter is used it should be chopped or broken into small pieces, and boiled for a considerable time—not less than nine or ten hours. Shin-bones will then yield about 19 per cent of their weight of fat and gelatine—the soup being, according to Dr. E. Smith, very nutritious, so that 6 lbs. of bones will produce a soup that contains the nutritive power of 2 lbs. of meat as far as carbon is concerned, and of 1 lb. of meat in respect of nitrogen; but although this may be so as regards the actual quantities of carbonaceous and nitrogenous matters present, yet it is very doubtful whether they are equally nutritious, for in the renowned experiments of the French Gelatine Commission it was found that the soup or jelly from boiled bones would not support the life of dogs, although raw bones, in like proportion, would.

Ox-tail soup is much richer than that from bones alone, as it contains the saline and other constituents of flesh. It is now a favourite and rather expensive soup, although at one time it was the humble fare, and almost the only nitrogenous food of the poor Protestant French refugees of Clerkenwell. Prior to the year 1689, or thereabout, the butchers of London left the tails attached to the hides, which were sent to the tanners of Bermondsey, but the poor French refugees, in their extremity of want, bought the tails for a mere trifle, and converted them into soup, which was soon found to be of excellent quality.

Soup made from meat should be obtained in the way already described—that is, a given weight of meat, chopped fine, should be allowed to macerate in its own weight of cold water, and should then be gradually heated to the boiling-point, after which it should be strained and pressed. In this way about 3 per cent of the nutritious matter of the meat is dissolved, besides the saline constituents. If the soup be simmered with the meat for some hours, a larger proportion of organic matter, chiefly gelatine, will be dissolved; and a good soup thus made from shin of beef will contain about 600 grains of solid matter in a pint, and of this about 39 grains are saline.

Lean meat contains about 25 per cent of solid matter, the rest being water, and of this from seven to ten parts are soluble in cold water; rather more than half of this is albumen and miochrome (colouring matter), which are coagulated by heat, and thus, if the cold solution of flesh be boiled, it contains only from 3 to 4 per cent of the meat; and when evaporated to dryness it constitutes the *extractum carnis* of Liebig. It can hardly be said, however, that the nutritive power of this extract is very great, for its chief constituents are certain acids, lactic and inosic, with enosite, creatine, creatinine, and an indefinite colloidal organic substance of a brown colour and syrupy consistence; besides which it contains the soluble saline matters of the meat, as phosphate and chloride of potassium, with a little chloride of sodium. Analyses of this extract, as found in commerce, have furnished from 41 to 60 per cent of water, from 22 to 41 per cent of organic matter, and from 8 to 16 per cent of saline matter. The extract is always acid; and it should be of a pale yellowish brown colour, with an agreeable meat-like odour and taste. It should also be perfectly soluble in cold water, and should not contain albumen, fat, or gelatine.

False views have been entertained of the nutritive power of this extract, for, as 1 lb. of it represents the soluble constituents of from 30 to 34 lbs. of lean meat, or from 45 to 48 lbs. of ordinary butchers' meat, it has been assumed that its nutritive power is in this proportion; but Liebig has taken care to correct this error, by showing that the extract, when properly prepared, merely represents the soup or beef-tea obtainable from that quantity of meat: and, as it is deficient of albumen, it must be conjoined to substances which are rich in this material, as beans and peas. No doubt the physiological action of the extract is due to the alkaloids which it contains; and as the former of these are of tea and coffee (theine or caffeine) in their effects on the body, it must be concluded that extract of meat is more of a vital restorative than a nutritious food. It is from this point of view that Parmentier, Proust, and even Liebig himself, are disposed to regard the physiological effects of the preparations. "In the supplies of a body of troops," says Parmentier, "extract of meat would offer to the severely wounded soldier a means of invigoration which, with a little wine, would instantly restore his powers, exhausted by great loss of blood, and enable him to bear being transported to the nearest field hospital;" and, in almost the same language, Proust remarks that "we cannot imagine a more fortunate preparation under these circumstances; for what more invigorating remedy, what more powerfully-acting panacea than a portion of genuine extract of meat dissolved in a glass of noble wine?"

As in the case of soup and beef tea, its nutritive power must be assisted by vegetables and other substances which are rich in nitrogenous matters. Conjoined, therefore, with wheaten flour, with peas or lentils, or even with the gluten obtained in the manufacture of starch by Durand's process, it may be made to have the nutritive power of meat. Already there is a preparation of it by Messrs. Peak, Frean, and Co., in which the extract is mixed with baked flour and pressed into small biscuits; indeed, as far back as the year 1851, Mr. Borden, jun., obtained a patent for combining extract of meat with flour, farina, or meal, and baking it in the form of biscuits. In this manner, by using the extract of 5 lbs. of meat with 1 lb. of flour, he produced biscuits which contained 32 per cent of nitrogenous matter; and 1 oz. of the biscuit grated into a pint of water, then boiled and flavoured, made a good soup. In the case of Liebig's extract of meat, 1 lb. of the preparation is sufficient, with the usual rations of potatoes and other vegetables, to make soup for 130 men; and a strong broth is made by dissolving a teaspoonful of it (about 150 grains) in half a pint of boiling water, and flavouring with salt and pepper.

A still more nutritious broth, containing the albumen of the meat, is obtained by infusing a third of a pound of minced meat in 14 ozs. of cold soft water, to which a few drops (4 or 5) of muriatic acid, and a little salt (from 10 to 18 grains) have been added. After digesting for an hour or so, it should be strained through a sieve, and the residue washed with 5 ozs. of water and pressed.

The mixed liquids thus obtained will furnish about a pint of cold extract of meat, containing the whole of the soluble constituents of the meat (albumen, creatine, creatinine, &c.), and it may be drunk cold or slightly warmed—the temperature not being raised above 100° Fahr., for fear of coagulating the albumen.

There are many questions connected with the economy of cooking which I have not time to discuss, but I may state that this Society has done good service for the community in obtaining valuable information as to the simplest and cheapest apparatus for the purpose. Foremost among them is the cooking-pot of Captain Warren. It is a sort of double saucepan, and is easily made by fitting a small-covered saucepan into a larger one. The inner vessel contains the joint or other thing to be cooked, and the outer one has a little water in it, so that the temperature in cooking can never exceed 212°. By this means the joint is cooked in its own vapour without coming into contact with water or steam, and thus it cannot lose its soluble constituents; and if it be desired to improve the flavour of the joint just cooked, it may be afterwards roasted for a short time before the fire. The loss in weight under these circumstances is not nearly so great as in the common way of cooking, and the flavour and tenderness of the meat are considerably increased; besides which, there is the certainty of cooking the joint equally throughout, without over-dressing it. Moreover, by the adaptation of a steamer to the outer vessel, vegetables may be also cooked at the same time. When the meat is boiled by this process, there is little or no loss of weight and even when it is afterwards roasted, for the purpose of improving its flavour, the loss is not nearly so great as when a joint is roasted in the ordinary way. In one experiment it was found that 15 lbs. of meat roasted in the usual manner, in the kitchen of the Cambridge Barracks, lost 4 lbs. 4 ozs. in weight, whereas the meat cooked in Captain Warren's pot, and then roasted, lost only 2 lbs. 15 ozs., so that there was a gain of 1 lb. 5 ozs.

Another apparatus of very great ingenuity is a cooking-pot from Switzerland, where the saucepan containing the joint and a little water is, after boiling for a short time, placed in a box lined with felt, and thus left for an hour or two to cook, the conducting power of the felt being so bad that the heat is retained in the most perfect manner. The apparatus is not only economical, but it is also excellently well suited for picnic parties or for soldiers on the march, who may thus secure a hot dinner, cooked while on the journey.

The cooking appliances of the poor are very imperfect, and hence they resort to the cook-shops of their neighbourhood; but even then their meals are scanty and wretchedly cooked. In the poor districts of London three-halfpence is the usual expenditure for a dinner by children—a penny going in pudding, and the halfpenny in potatoes. If they pay twopence they are allowed to sit down, and have a little gravy with it. Everybody has heard how the poor of Paris dine *à la squirt*, where the tin soup basins are nailed to the table, and where the attendant Leonoras draw up the seething soup from a hidden cauldron by means of a huge syringe, from which it is driven out into the customer's basin. The price of the meal (4 sous) must be instantly paid down, or the callous handmaid sucks up the soup again into the monster squirt. Scenes like this, and even worse than this, in the abodes of the poor, have urged philanthropists to seek a better means of supplying their wants, without trespassing upon the dangerous ground of charity. In Paris, an enterprising widow (Madame Robert) conceived the idea of giving a poor man a good dinner for two-pence. Her daily bill of fare was cabbage-soup, a slice of bouilli (beef), a piece of bread, and a glass of wine; and thus, in the neighbourhood of the Marché des Innocents, did she daily provide for some 6,000 workmen, who took their dinners in the open air, but sheltered from the weather; and she gained a farthing by each guest. In this country a like benevolence has set on foot, with more or less success, in different places, *restaurants* for the poor. In Glasgow, for example, the working-class dining-rooms, which are far above the rude accommodation of Madame Robert, are established to provide a substantial dinner for 4d. or 5d. Long ago the special correspondent of the *Daily Telegraph*, in writing about them, said that he obtained a capital dinner of good pea-soup, boiled beef, 10 ozs. of potatoes, and pudding—more than he could eat—for the sum of 5½d.; and a writer in the *Times* also stated that for 4½d. he had a pint basin of pea-soup, a plate of hot minced collops, a plate of potatoes, and 8 ozs. of bread; while his companion had, for the same sum, a pint basin of broth, a plate of cold beef, a plate of potatoes, and a slice of plum pudding, all excellent in their quality, and well cooked. The practice in these places is to provide daily a variety of hot foods—as soup, broth, potatoes, rice, cabbage, pudding, tea and coffee—besides bread and butter, cold pressed beef and ham; and every ration, except meat, is so apportioned as to be sold at the uniform price of a penny. The meat costs three-halfpence; and, with the view of clearing off the remainder of the soup after the proper dinner hour, so that a fresh quantity may be made every day, it is the practice to sell the soup and broth, at half-price, from six o'clock to eight o'clock in the evening, and then to give the remainder away. All the articles are of the best quality, and are well cooked. They are bought by contract at wholesale prices; and, although they are sold so cheaply, yet they yield a small profit, and so give the system the stability of a commercial enterprise.

Very recently, too, Mr. Riddle has proposed, in a paper which was read before this Society, that arrangements might be made for cooking dinners on a large scale, and sending them out to the houses of the poor. He proposes to prepare, daily, good rations of roasted, baked, and boiled meat, with vegetables, and to send them out in 2 lb., 4 lb., or 6 lb. tin canisters, all ready for immediate use, and kept warm in little compartments of a properly-constructed cart. There would be no difficulty about this, and the meat might be delivered in excellent condition and with great punctuality. None but those who are acquainted with the utter helplessness of the poor in the matter of cooking food, or who know the difficulties of even better classes of persons in this matter, can form any notion of the value of such a proposition; and I should be glad to see it realised.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 19, 1868.

Dr. Warren de la Rue, F.R.S., President, in the chair.

In accordance with the notice given at the last meeting, an extraordinary general meeting of the society took place at eight o'clock.

The President, in introducing the business of the special meeting, observed that it was convened under the provisions of Law 13, which permitted the convocation of such a meeting when any question arose which required the concurrence of the entire society. Their object on the present occasion was to discuss certain proposed alterations in the bye laws, by which a greater number of Fellows would be admitted to a share in the government of the society. The council had long felt anxious to effect this object, and finding that the charter did not permit them to increase the number of the council, they now proposed to raise the number of vice-presidents who had not filled the chair, from four to six. This alteration would, it was felt, infuse some new blood into the governing body.

Formal alterations in the bye-laws to provide for the proposed change were then put to the meeting by the President, and were carried unanimously.

The meeting was then resolved into an ordinary one.

After the formal business, the following certificates were read:—

For the first time, Mr. W. W. Stoddart, Mr. John Hughes, Mr. T. Rowan; for the second time, Mr. E. J. Tosh, Mr. G. Gowland; for the third time, Dr. W. J. Balmer, Calcutta.

The last-named gentleman was then ballotted for, and was declared duly elected.

The President then announced that a change in the arrangements for the meetings had become necessary. He had just returned from witnessing the demolition going on in Paris to find himself in similar quarters here. The arrangements with the Royal Society had, as the Fellows were aware, fallen through, and their pleasant tea after meeting was no longer possible. The Linnean Society had kindly accommodated them for that evening, and care would be taken to make fresh arrangements for next meeting.

Mr. W. H. Perkin then made a communication "*On the Action of Chloride of Lime on Aniline.*"

About twelve years since the author, when experimenting upon the process of converting aniline into aniline purple by means of a salt of aniline and a bichromate, also made experiments upon Runge's well-known reaction for aniline, to see if the colour of the solution obtained in this manner was due to aniline purple or not; his results, however, were decidedly in the negative. But two or three years after the French manufacturers began to experiment upon aniline purple, and succeeded in obtaining it by employing chloride of lime as the oxidising agent.

These opposite results could not at the time be accounted for, but upon repeating his experiments lately the author has found his conclusions to be perfectly correct.

Reference was made to the name Runge first gave to aniline, which it will be remembered was kyanol or blue oil, on account of the blue or blue-violet colouration it gave with chloride of lime; and by performing Runge's experiment it was shown that an indigo-coloured fluid is obtained, appearing rather dull, because slightly turbid; it may be rendered perfectly clear by the addition of alcohol, and then presents, by transmitted light, a brilliant colour not unlike ammoniacal sulphate of copper and not at all like aniline purple. Moreover, silk immersed in the coloured fluid obtained by this reaction is dyed a dull blue-lavender shade.

Experiments were made to isolate this colouring of Runge's, and were tolerably successful, so that it was obtained in a solid condition, and was found to dissolve in cold alcohol with a blue colour, and when evaporated spontaneously left the colouring matter as a solid, possessing a coppery coloured surface.

This colouring matter the author proposes to designate as "Runge's blue." It appears to be the salt of an organic base differing entirely in its behaviour with caustic alkali from a salt of mauveine, as its alcoholic solution gives with potash a pale reddish brown colour, a salt of mauveine producing under the same circumstances a solution of a violet colour.

Runge's blue dyes silk a blue or blue-violet shade, but does not take on to the fibre so readily as aniline purple.

The question as to how the manufacturer produces aniline purple by oxidising aniline with chloride of lime, seeing the result of that oxidation is the formation of Runge's blue, was next considered, and shown to be the result of proceeding a step further.

It is found that Runge's blue when boiled with water acidulated with acetic acid, is entirely decomposed, yielding aniline purple, and this is the additional step taken by the manufacturer. He boils his product with water acidulated with acetic acid for the purpose of extracting the aniline purple, but by performing this operation he not only gets his colour in solution, but actually forms it.

To show that this is not a process of purification, silk was dyed with Runge's blue, and in paste exposed to the action of steam for a few moments, when it was seen that the parts subjected to the action of steam were changed from a blue or blue-violet to the ordinary shade of aniline purple. A similar effect is also produced by the influence of heat alone.

An alcoholic solution of Runge's blue was found to be very rapidly decomposed into aniline purple by boiling, and by adding a few drops of sulphuric acid to the boiled product; crystals of sulphate of mauveine were deposited on cooling.

The same decomposition also takes place in the cold in the course of a day or two. This colouring matter does not appear to decompose so rapidly when in the solid state, and when applied to silk its decomposition into aniline purple takes place very slowly. The instability of this substance has prevented the author from establishing its formula.

From the above results it was clearly shown that the colouring matter obtained by Runge is an entirely different substance to aniline purple, but that it is capable of yielding it when decomposed by heat.

Mr. Perkin also exhibited some beautiful specimens of benzoic and phthalic acids obtained from naphthaline, and also chloroxynaphthalic acid and some of its coloured salts which are manufactured on the large scale by Messrs. Depouilly, Frères, of Paris.

The President could not avoid recalling the time when he first saw Dr. Hofmann perform Runge's experiment of treating aniline with chloride of lime. He remembered saying to him, "Now, Hofmann, if you can fix that colour there is a fortune for you." It appeared, however, that it was not the right colour after all. The colour exhibited by Mr. Perkin seemed to offer an advantage to ladies who were fond of frequent changes in their costume. A lady would merely have to stand near the fire in a ball-room and her lavender silk dress would soon become a purple one.

Dr. Muller enquired whether Mr. Perkin had made any experiments upon the oil which Marignac obtained by the action of potash on chloride of chloronaphthaline. This substance was very much like chloropicrin, though of course different from it. It would be very interesting to ascertain by comparative experiments whether the formula now given was correct. The action of nascent hydrogen upon it should likewise be studied, for it ought, under these circumstances, to yield methylene-diamine.

Mr. Perkin had made no experiments in the direction indicated.

Dr. Odling remarked that it would confer a great benefit upon science if chemists would follow the example of Mr. Perkin and publish the results of their repetitions of previously published, but little known, processes. The primary object of the society was, of course, the publication of new discoveries, but the immense number of the new processes which were published rendered it impossible to repeat them all, and hence the records of confirmatory experiments were of the greatest value.

The President enquired whether any of the chloroxynaphthalates exhibited, some of which, and particularly the zinc and copper salts, had a very beautiful colour, had been tried as colours.

Mr. Perkin said they had, and had been found to be very stable. This observation was confirmed by Dr. Müller, who stated that the great objection to their use arose upon the score of expense. The President suggested that this would probably be only a temporary difficulty.

"*Analysis of a Meteorite from South Africa,*" by Professor Church.

The meteorite in question was seen by a native to fall at Daniel's Knil, a place about two days' journey N.N.E. of Grigua Town. The native said that it was warm and smelt of sulphur when he picked it up. He offered it to the Rev. James Good, a missionary in Grigua Town, who declined it, and recommended him to take it back to the place where he found it! Instead of doing so, he gave it to a Grigua chief, Captain Nicolas Waterboer, and from his hands it passed into those of Mr. J. R. Gregory, of Russell Street, Covent Garden, and is now in the British Museum.

It was small in size, of an irregular oblong form, weighing 2 lbs. 5 ozs. It was covered with a dark grey crust, speckled here and there with reddish brown spots, these spots arising from a partial oxidation of the ferruginous materials of the stone. Its density was rather low, namely, 3·657 and 3·678, as found in two determinations; but it is probable that the iron contained in the stone is in larger proportion in some parts than in those analysed, and therefore, were the density of the whole meteorite to be taken, it would very likely be as high as 3·8, or thereabouts.

The following was given as the analysis of the meteorite:—

Nickel-iron containing 5·18 per cent nickel ..	29·72
Troilite, FeS	6·02
Schreibersite	1·59
Silica and Silicates, chiefly olivine and labradorite..	61·53
Carbon, oxygen, other constituents, and loss	1·14
	100·00

The iron-nickel was dissolved out of the stone by long digestion with dilute hydrochloric acid, the two metals being separated by the barium carbonate process. The sulphur was determined by oxidising the troilite with potassium chlorate, and nitric acid.

The schreibersite, a somewhat undetermined species, was approximately estimated by multiplying the unoxidised phosphorus in the stone by ten.

The composition of the meteorite was not quite uniform, one fragment yielding 39·2 per cent of nickel-iron, and another only 48·99 per cent of silicates.

"*On the Action of Salt on Chessylite,*" by Professor Church.

The author had, in 1864, commenced a series of experiments with the view of elucidating the formation of atacamite by the action of sea water on copper ores. The following was the only really successful experiment:—2 grammes of very pure chessylite, having the composition—

$$2CuCO_3,CuH_2O_2,$$

and a very pale blue colour, were immersed in 200 c.c. of a 10 per cent solution of pure salt. The blue colour slowly changed to pale green, and by October of the present year the whole of the CO_2 of the mineral had been displaced by chlorine, and remained in the solution in the form of sodium carbonate. The mineral was now found to have the formula $2CuCl_2.9CuH_2O_2,3aq$. It was, therefore, analogous to atacamite, though it did not exactly correspond with it in composition. The water which it contained was not given off at 100°.

The **President** remarked on the length of time required for the completion of experiments of this kind. With respect to the meteorite he inquired whether the carbon found could be assigned to any other constituent, or whether it existed in the form of graphite.

Dr. **Muller** enquired whether a direct determination of the carbon had been made. The absence of carbon in meteorites was so general that many were rejected because they were found to contain that element. He believed, however, that a few undoubted instances of its occurrence were known.

Professor **Church** pointed out that the minute quantity of carbon present, not exceeding ·1 per cent, together with the smallness of the fragments at his command, had precluded him from estimating its quantity. He had only been able to ascertain its presence qualitatively.

The **President** reminded Dr. Müller that he had seen at his house a meteorite, the fall of which, at Montaubin in the centre of France, had been witnessed. It contained a very notable proportion of carbon, and others of a similar kind had since been traced. It was evident that the presence of carbon afforded no reason for doubting the meteoric origin of iron. Meteorites from different regions of space might have very different compositions, which made it the more remarkable that no new element had ever been obtained from one.

Dr. **Muller** endorsed the observations of the President, and added that distinct traces of a hydrocarbon had been found in one instance.

The **President** then described briefly some experiments which he had recently seen at the house of his friend Mr. Gassiot with a battery of 3,600 elements of zinc and carbon charged with mercuric chloride. This battery was able to transmit the current through vacuum tubes without the interposition of a coil. He took the opportunity of testing the electro-motive force of the arrangement in order to conpare it with that recently suggested by Dr. Hugo Müller and himself. The latter instrument compared very favourably with the far larger one of Mr. Gassiot.

The Society then adjourned until Thursday, the 3rd of December.

GLASGOW PHILOSOPHICAL SOCIETY.

Chemical Section.

The opening meeting of the Session took place in the Society's rooms, Andersonian Buildings, on Monday, the 9th inst.

Dr. **Anderson**, the President, delivered an address on "The Present Aspects of Chemistry, and its Relations to the Arts." In the course of his remarks he referred more particularly to the modern theories relating to chemical changes, and discussed at some length the views of Sir Benjamin Brodie, as set forth in his "Calculus of Chemical Operations." He also alluded to the progress of chemical science on the Continent, and contrasted the splendid new laboratories now being established in Germany, with the comparatively indifferent facilities at present existing in this country for the prosecution of chemical study and research. He also drew attention to the fact that many of the manufactures successfully carried on on the Continent, appeared to be impracticable in England, and referred this circumstance to the superior technical training and skill of continental workmen.

A vote of thanks was given to Dr. Anderson for his appropriate and interesting address.

The Annual General Meeting was held in the Society's Rooms, Andersonian University Buildings, on Monday evening, the 23rd inst.

The following gentlemen were elected office bearers:—

President—
Thomas Anderson, M.D., F.R.S.E, Professor of Chemistry in the University of Glasgow.

Vice-Presidents—
Dr. William Wallace, F.R.S.E.
Alexander Whitelaw.

Treasurer—
William R. Hutton.

Secretary—
Robert R. Tatlock, F.C.S.

Council—
James H. Bald.
James Cowper.
John Ferguson, M.A.
John Jex Long.
William Macadam,
James Mactear,
John Paynter,
Edward C. C. Stanford, F.C.S.

Mr. **James Mactear**, F.C.S., gave an interesting description of Gay Lussac's apparatus for absorbing the waste nitrous gases of vitriol chambers, and experimented very successfully with a working model of the arrangement. He afterwards detailed the various methods used for denitrating the nitro-sulphuric acid produced. In answer to an enquiry, Mr. Mactear stated that the question, whether the vitriol manufacture is more economically conducted with or without the adjunct of the "Gay Lussac," depends upon the market price of nitrate of soda, and other circumstances.

Mr. **Bald** afterwards exhibited some efflorescent and deliquescent crystals, preserved by a coating of paraffin.

University of London.—The following gentlemen have passed the second B.Sc. examination:—Second Division. Bennett, Alfred William, M.A., Univ. Coll.; Hopkinson, John, Trin. Coll., Camb., and Owen's, Manchester; Maxwell, Theodore, Univ. Lond. and King's, Cambr.; Ricks, George, King's Coll.; Robinson, Arthur, Owen's Coll.; Sheldon, Charles, B.A., Owen's Coll.; Tilden, William Augustus, private study; and Wormell, Richard, M.A., University College. *Honours in Chemistry.*—First Class. Tilden, William Augustus (disqualified by age from receiving the University Scholarship).

FOREIGN SCIENCE.

Paris, Nov. 25, 1868.

The Testing of Colouring Matters.—Glycerine Bath.—New Voltaic Battery. Academy of Sciences: Researches on the Bleaching of Tissues.—Chromiferous Iron.—Trichlorinated Acetal from Ethyl and the Formation of Chloral.

In technical chemistry, a useful contribution has been made by M. Houzeau,—we refer to his paper entitled "Observations on the Mode of Testing Colouring Matters, and particularly Extract of Logwood." M. Houzeau remarks that as long as the colouring matters sent into commerce are adulterated with inert matters, such as sand, exhausted tar, sawdust, molasses, &c., successive exhaustions furnish the required indications. When, however, substances of less commercial value, like sumac, extract of chesnut, &c., are added, this is not the case. For while these ingredients, added to the colouring matters to lower their price as much as possible, do not possess colouring power to any extent in the proportions employed in dyeing, they nevertheless, when present in extract of logwood or madder, exalt very notably the tinctorial power of these important products. Thus, logwood mixed with 10 per cent of chesnut, though it contains less hæmatine or hæmatoxyline than the genuine extract, yields with iron and aluminous mordants, richer shades. It is therefore evident that, by adulterating the colouring matters of commerce with perfectly inert substances, and correcting the diminution of strength by a determinate amount of certain astringent principles, as extract of sumac or chesnut, the usual examination will not detect the fraud. Some other simple means of testing are rendered necessary. Any adulteration of molasses is of course easily detected by the exaggerated proportion of glucose present in the suspected extract. But it is considerably more difficult to detect the astringent matters, and especially the chesnut. The difficulty of separating the astringent principles, and distinguishing those which exist normally in the extract led M. Houzeau to adopt the following method:—1 gramme or 1 decigramme of the suspected extract, previously dried at 110°, is entirely exhausted with absolute ether, and the weight of soluble matter noted. The residue is then treated with absolute alcohol until completely exhausted. A comparison of the results thus obtained with those furnished by a genuine extract treated in the same way, furnishes a very good indication. For example, 100 parts of extract gave—

	Matters soluble in ether.	Matters soluble in alcohol.
Genuine extract ..	87·1	14·3
Suspected extract ..	76·9	19·5

These figures indicate the weight of the residue obtained by evaporating the solution, and comprise consequently products of the oxidation of the alterable matters. Extract of chesnut scarcely yields anything to ether, while it is sensibly soluble in alcohol. It is therefore natural to find in the suspected extract more principles soluble in alcohol than in the genuine extract. A further knowledge concerning the principles present may be obtained by testing the dyeing power of the alcoholic and ethereal extracts. For the same weight, the products soluble in alcohol and ether of every extract should dye, in a similar manner, the same surface of calico if they have the same composition; this is the result of experiment. In the sample above cited, the same weights of the products soluble in ether of the genuine and the suspected extract have tinted equally the same surface of mordanted tissue, while equal weights of the matters soluble in ether have furnished totally different results.

M. Vogel recommends the substitution of glycerine for oil when constant temperatures above 100° C. are required. Glycerine of 1·25 density boils at 128°. A mixture of glycerine and water, in equal proportions, boils at 102°; glycerine 150 parts and water 100 parts, at 106°; and glycerine 175 parts and water 100 parts, at 109°. The inconveniences of the oil bath are thus unnecessary.

A new arrangement for furnishing currents of electricity has been made known by M. Ney. It is composed as follows:—(1) a vessel filled with solution of chloride of ammonium, containing a plate of amalgamated zinc; (2) a porous cylinder filled with carbonate of copper, into which a plate of copper plunges. To maintain the battery in action, it is only necessary to add solid chloride of ammonium from time to time. In military telegraphy, where the pile should be capable of transport, the outer vessel might be filled with sand saturated with a solution of chloride of ammonium in the place of the solution. This arrangement recommends itself on the score of cheapness, for native carbonate of copper answers sufficiently well, and it likewise only requires attention while in actual use. Carbonate of copper is insoluble in a solution of chloride of ammonium, but upon closing the current, the chloride is decomposed into hydrochloric acid and ammonia; the hydrochloric acid collects at the zinc pole, the ammonia at the copper. The carbonate of copper becomes soluble, and its reduction gives rise to a secondary current having the power of a Daniell's element. This form of battery is perfectly constant.

The following memoirs were communicated to the Academy on the 12th October:—"Researches on the Bleaching of Tissues," by M. Kolbe; "Temperature of the Atlantic Ocean compared with that of the Air, and with the Ozonometric condition from St. Nazaire to Havanah," by M. Poey; "Chromites of Iron," by M. Clouet; "The Trichlorinated Acetal from Ethyl, and on the Formation of Chloral," by M. Paterno.

M. Clouet has analysed a specimen of chromiferous iron which has the composition $Cr_2O_3,2FeO$. In analysing specimens of this mineral from various localities, he has always obtained a constant relation between the oxides of chromium and iron, when taken from the same locality, especial care being taken to select for analysis the samples differing most in appearance. Chromites of iron are easily produced artificially. For this purpose a concentrated solution of sulphate of protoxide of iron, and solution of sesquichloride of chromium, are mixed in the proportion necessary for the combination it is desired to form, and ammonia added in slight excess. The precipitate is filtered as quickly as possible, and heated with a little carbonate of ammonia and borax in a platinum crucible to bright redness. All the physical and chemical characters of the corresponding native chromiferous iron are possessed by the artificially prepared chromite: density, insolubility in strong and boiling acids, colour, and metallic lustre. By calcining the mixture $Cr_2O_3,2FeO$ with borax, the compound may be obtained crystallised in octahedra.

Liebig first obtained chloral in 1832 by the action of chlorine on alcohol. Two years later, M. Dumas established the exact composition of this body, and endeavoured to explain its formation. He was led to conclude that in the action of chlorine on alcohol, acetic ether is first formed, and that this ether afterwards produces chloral, by the substitution of 6 atoms of chlorine for 6 atoms of hydrogen. More recently still, M. Regnault, considering the formation of aldehyde in the first period of the action of chlorine on alcohol, supposed the chloral to result from the action of the chlorine on the aldehyde; and he considered this body as the trichlorinated aldehyde. This hypothesis, which made chloral from trichlorinated aldehyde, seemed confirmed by the transformation of this body into trichloracetic acid effected by M. Kolbe. But on the other hand, when M. Wurtz demonstrated that, in the action of chlorine on aldehyde, chloride of acetyl is formed, from which chloral cannot be derived, this seemed altogether improbable. Professor Lieben, in 1868, investigated the action of chlorine on aqueous alcohol, and found that, in this case, the products formed are chiefly the chlorinated derivatives of acetal. He concluded from this that probably the chloral results from the decomposition of the trichlorinated acetal under the influence of hydrochloric acid, and he expressed the transformation of alcohol into chloral by a series of reactions, the result being in succession, aldehyde, acetal, monochlorinated acetal, bichlorinated acetal, trichlorinated acetal, chloral. Thus—

$$C_2H_6O+2Cl=2HCl+C_2H_4O\text{, aldehyde.}$$

$$C_2H_4O+2C_2H_6O=H_2O+C_2H_4\left\{\begin{matrix}OC_2H_5\\OC_2H_5\end{matrix}\right\}\text{acetal.}$$

$$C_2H_4\left\{\begin{matrix}OC_2H_5\\OC_2H_5\end{matrix}\right.+2Cl=HCl+C_2ClH_3\left\{\begin{matrix}OC_2H_5\\OC_2H_5\end{matrix}\right\}\text{monochlorinated acetal.}$$

$$C_2H_3Cl\left\{\begin{matrix}OC_2H_5\\OC_2H_5\end{matrix}\right.+2Cl=HCl+C_2H_2Cl_2\left\{\begin{matrix}OC_2H_5\\OC_2H_5\end{matrix}\right\}\text{bichlorinated acetal.}$$

$$C_2H_2Cl_2\left\{\begin{matrix}OC_2H_5\\OC_2H_5\end{matrix}\right.+2Cl=HCl+C_2HCl_3\left\{\begin{matrix}OC_2H_5\\OC_2H_5\end{matrix}\right\}\text{trichlorinated acetal.}$$

$$C_2HCl_3\left\{\begin{matrix}OC_2H_5\\OC_2H_5\end{matrix}\right.+2HCl=2(C_2H_5Cl)+C_2HCl_3O\text{, chloral.}$$

The discovery of M. Beilstein that aldehyde is obtained in treating acetal by acetic acid, and particularly the fact observed by M. Paterno of the production of bichlorinated aldehyde by means of bichlorinated acetal, are fresh arguments in favour of Lieben's theory. To demonstrate this theory completely, it was at the same time necessary to prove that trichlorinated acetal exists amongst the products resulting from the action of chlorine on alcohol, and that this body can be converted into chloral. This M. Palermo proposed to himself to verify by experiment.

Trichlorinated acetal, together with bichlorinated acetal, is obtained by the action of chlorine on alcohol at 80°. Water is added to the product, and the oil which collects at the bottom of the vessel washed with potash and distilled. Trichlorinated acetal is contained in the portions which pass over above 185°. To isolate it, these portions are distilled in a current of steam, the last quarter being collected separately; the portion thus separated is redistilled in the same way. After this operation has been repeated several times, the last portions being always separated, the steam commences to carry over a substance which crystallises upon reaching the receiver. This substance, compressed between folds of blotting paper, distilled, and crystallised from alcohol or ether, constitutes pure trichlorinated acetal. M. Palermo separated from 5 kilogrammes of alcohol, 10 grammes of trichlorinated acetal with difficulty, while he obtained at the same time nearly 1 kilogramme of bichlorinated acetal. Trichlorinated acetal crystallises in brilliant needles, resembling in aspect caffeine; it melts at 72°, and boils at 230°, decomposing a little. Alcohol and ether dissolve it easily. The following analytical results were obtained:—Carbon, 32·10, hydrogen, 4·87, chlorine, 47·92; theory requiring, 32·05, 4·96, and 48·05. When trichlorinated acetal is heated to 150° with ordinary sulphuric acid, a liquid, which appears to be identical with chloral, distils. But the quantity obtained was not sufficient to enable it to be purified for analysis. These experiments were made in the laboratory of the University of Palermo.

NOTICES OF BOOKS.

Sanitary Siftings, or Results of Sewage Systems Compared. London: E. and F. N. Spon, Charing Cross.

The A.B.C. Sewage Process. London: Yates and Alexander, 7, Symonds Inn, Chancery Lane.

Report on the Sewage of the City of Melbourne, by Sydney Gibbons, F.C.S., F.R.M.S., &c.

The numbers of a community may be limited by two causes—(1) by bad sanitary arrangements; (2) by the insufficiency of food to support an increase. Such is the general statement with which the writer of the first pamphlet starts. The disposal of excrementitious matter is considered, and doubtless truly, as closely connected with pure air and water, and thus as the all-important question.

Of the schemes already proposed at different times that of filtration is first considered, and dismissed as useless. In connection with the precipitation of sewage we find the following:—

"As the alchemist of olden time passed his life in the vain pursuit of the philosopher's stone or the elixir vitæ, so in the present age the resources of chemistry have been wasted in the endeavour to extract wealth by precipitation into a portable and concentrated manure of the valuable parts of sewage." That many of the proposed plans have been complete failures is not to be denied, among others the process employed by the Patent Solid Sewage Manure Company at Leicester, and likewise the works carried on at Montfauçon in Paris. But the mention of Leicester brings to mind the experiments of Messrs. Sillar and Wigner; of these we shall have occasion to speak immediately. Even improvements have been recently made in the mode of treating the refuse collected at Montfauçon.

Regarding the removal of sewage by water, among other proposed improvements noticed, is the flushing of the sewers with 42,000,000 gallons of water additional. It appears the water companies could only supply 5,000,000 additional. We scarcely agree with the writer in the remark, "Were it otherwise, water would not be a remedy, for the more water the more smell, as it supplies the hydrogen for forming the deadly sulphuretted hydrogen of sewage." However, the advantage for the dry method is that while water aids fermentation, earth destroys it. The opinions of several good authorities are favourable to the earth system; thus Lord Leigh says, "I have thought a great deal on the subject of these earth closets, and we have adopted the plan with a reformatory school in this neighbourhood, of which I am chairman, and used it with great success." It need scarcely be remarked that the value of the refuse matter as manure is greater when earth is used instead of water. Little is required, we are told, to establish the efficacy, feasibility, and cheapness of the earth system. Dr. Mouat has borne testimony to the Government of India as to its very great value, and the reports of the Commission of Enquiry in India, showing, amongst other things, a great decrease of mortality in gaols and hospitals in that country, are most positive as to its efficacy. We believe that too little is known regarding earth closets, and we are at the same aware that one authority on the sewage question has expressed himself somewhat favourably concerning them. The Government and Secretary of State for India awarded the Rev. Henry Moule £500, in token of their sense of the benefits conferred upon the inhabitants of India by his system.

In connection with the same subject, we have a description of Messrs. Sillar and Wigner's A.B.C. sewage process, and the experiments made at Leicester, Tottenham, and Leamington. The A.B.C. mixture derives its name from the initials of the three principal ingredients, animal charcoal, blood, and clay. When this compound is suspended in water and added to the sewage, a precipitate in large flakes is immediately produced; the supernatant liquor is drawn off into a tank and a small quantity of perchloride of iron solution added. The iron compound serves to remove the sulphuretted hydrogen. It has been found convenient to add a certain proportion of alum, since the process is thereby accelerated. The authors very naturally deplore that one of the most serious mishaps in connection with the arrangements at the Abbey Meadow Sewage Works at Leicester should have happened on one of the days when the samples were being taken by the Royal Commission. The dam between the tanks being washed away, about 150,000 gallons of sewage flowed into the tank containing the sewage under treatment by the A.B.C. process. "As an illustration of the injurious effects produced by the accidents to the dam, an analysis marked with a star may be pointed out. This sample, which was taken during the visit of the Royal Commission, contained nearly as much sewage as purified water. It is not to be wondered at that it contains 18 grains per gallon of organic matter."

As to the value of the precipitate for agricultural purposes, we find that the material obtained from the Leicester experiments contained 4½ per cent of ammonia and that a considerable quantity was sold on the London Exchange at 70s. per ton. The authors state that two independent analyses give valuations of £3 17s. 3d.; they enjoin the necessity of treating the residuum with acid before allowing to dry, so that the ammonia may be fixed, and remark, "Dr. Frankland's estimate of a sample allowed to dry without the necessary addition of acid, whereby a large portion of the ammonia was lost, is (even then) £1 13s. 0¾d. per ton!"

The following results will enable a judgment to be formed upon the process:—

"1st. The sewage contained 43·02 grains per imperial gallon of organic matter. Of this the A.B.C. process precipitated 33·33 grains, leaving only 9·69 grains in the water, and this from an average of fifty samples taken at intervals during the progress of the experiment.

"2nd. Hitherto the lime process has been acknowledged to be the best, and the Leicester mode of conducting it to be the best of its kind. The A.B.C. contrasts most favourably with this, inasmuch as from samples taken at the same time from each, the water contained as follows:—

"Water from the A.B.C. contained 9·69 grs. per imp. gall.
,, ,, lime ,, 16·18 ,, ,,

having precipitated from the sewage the following proportions:—

"Organic matter precipitated by the A.B.C. 77·48 per cent
,, ,, ,, lime 62·39 ,,

"3rd. Of the nitrogen in the form of ammonia in the sewage, nearly all is dissipated by the lime process, but by the A.B.C. about 80 per cent was retained in the residuum.

"4th. Of the phosphates in the sewage, the lime process threw down 82 per cent, in a form unavailable, owing to the presence of lime; but the A.B.C. threw down the whole, and in a form readily available.

"5th. During the act of precipitation by the A.B.C. process there was no objectionable odour, whilst that from the lime was 'horribly offensive,' owing, of course, to the ammonia and other vapours being driven into the air by the lime.

"6th. The water from the A.B.C. is in no way detrimental to fish in the river. We have fish which have been for some weeks living in the purified sewage."

On the conclusion of the Leicester experiments, two smaller ones were made at Leamington with about 60,000 gallons of sewage.

A considerable number of analytical results are appended, from which we extract the following, as perhaps of most importanee, since there seems to be no doubt whatever that the liquid after precipitation is not offensive, and the main question, therefore, we take it, is the manurial value of the precipitate:—

	Leicester residuum dried in bulk.		Leamington residuum.
Water	13·79	.. ..	6·76
Organic matter	46·93	.. ..	29·42
Alkaline salts	4·97	.. ..	13·71
Earthy salts, containing phosphoric acid = 1·31	12·88	= 1·17	23·83
Silica	21·43	.. ..	26·28
	100·00		100·00
Nitrogen = Ammonia.. ..	4·67	.. ..	3·79

According to Mr. Wigner's analyses, the residuum possesses considerable value as a manure; the authors expect that instead of the disposal of sewage being a heavy expense, it may be made a source of revenue. The question, in the case of most towns, will not be—Can the supernatant water be mixed with river water from which the supply is afterwards to be drawn? If such were the case, notwithstanding the small amount of organic matter remaining, objection might be urged as to the quality of this organic matter, and the quality of organic matter in water is very uncertain. Hence we are inclined to think that the process is of considerable value.

The Health Committee of the City Council, Melbourne, instructed Mr. Sydney Gibbons, F.C.S., to investigate the nature of Melbourne sewage, with particular regard to the efficacy of a certain filtration process. It may be necessary to inform our readers that Melbourne has no sewers. Up to the present time, cess-pits have been employed for the reception of excreta and refuse of all kinds; latterly urine and other liquid refuse matters have been poured into the street gutters, with flushing water. Mr. Gibbons explains in his report the fermentation which urine undergoes. The filter, which it was desired to know more about, contained animal charcoal; this filter was supposed to retain the solid excreta, and to so purify all the other matters that the liquid issuing would be inoffensive. "The suspicion that it was chemically inoperative and mechanically incomplete was fully borne out."

The earth system, the merits of which we discussed in commencing, deserves the notice of the Melbourne Council; the conditions seem to us precisely suitable.

CORRESPONDENCE.

COHESION FIGURES.

To the Editor of the Chemical News.

SIR,—As I see that you refer to the production of Professor Tomlinson's beautiful cohesion figures of oil, &c., in the last number of the CHEMICAL NEWS, it may possibly interest your readers to know that these curious forms can be easily exhibited to a large audience. At the evening scientific meeting of this society, held on Monday, the 16th inst., I succeeded perfectly, with the aid of Mr. Yeates, the excellent optician of this city, in projecting the cohesion figures of oils of lavender, cod liver, and castor, and that of benzole, upon the ceiling. A beam of light from the oxyhydrogen lamp was thrown, by means of a mirror, at a small angle upon the surface of perfectly clean water contained in a circular beaker. A double convex lens of long focus was now placed in the path of the reflected beam, and an image of the surface of the water formed upon the ceiling—a distance of about 15 feet. On placing a drop of oil of lavender on the surface of the water, the exquisite play of colours which precedes the formation of the peculiar cohesion figure of this oil appeared with unexpected brilliancy on the screen, and the gradual development of the somewhat characteristic pattern which the oil affords could be easily watched from a very considerable distance. The experiments can obviously be extended to any required length, and I merely mention the matter here since Professor Tomlinson, in the account of his researches which I had the pleasure of listening to at the Manchester Meeting of the British Association, contented himself by exhibiting the mode of experimenting he employed and fine drawings of the cohesion figures afforded by different substances.

Before closing this hasty letter you will, perhaps, allow me to offer one or two other suggestive remarks.

Since the valuable "Dictionary of Chemistry" of Mr. Watts has now been successfully completed, I think most chemists will agree with me that it would be a matter of considerable regret that any of the advantage gained by the publication of so important a work should be lost by the necessarily growing incompleteness of its contents. I would, therefore, suggest the publication of an annual volume of the dictionary, thus in one sense following the example of our German brethren, but in reality, following the original plan of the work, and enabling British chemists possessing a copy of the dictionary to accurately appreciate the extent and character of the annual progress made in chemistry. That this would be a boon there can be no doubt, since few chemists can spare the time necessary to keep themselves thoroughly *au courant* with the progress of our science in more than two or three of its many branches. I would also draw the attention of chemists to the advantages which may be derived from the employment of Professor Everett's "Universal Proportion Table," in the routine calculations required in analytical work. The table is essentially a greatly extended slide rule. When its use is once understood all the troublesome sums in proportion, &c., so constantly necessary, can be performed by simple adjustment and inspection with considerable accuracy. The table is published by Longmans, and costs but a few shillings. I have had it in use in my laboratory for some time past with considerable advantage.—I am, &c.,

J. Emerson Reynolds.

Laboratory, Royal Dublin Society,
Kildare Street.
November 24th, 1868.

PERIDOTE METEORS.

To the Editor of the Chemical News.

Sir,—After reading M. Meunier's remarks on my letter in No. 467 of the Chemical News, I looked over the whole of the analyses we possess of meteoric stones, and I find that, with the exception of the remarkable stone of Chassigny, to which I called your attention, no aërolite has ever shown so much as 75 per cent of peridote, as found in M. Pisani's analysis of the stone which fell this year at Ornans; M. Pisani was, therefore, fully justified in calling attention to this fact, and my letter merely furnished one more instance—viz., a meteoric stone containing even more than 75 per cent of peridote.

Now, with regard to the presence of metallic iron in the Chassigny meteorite, M. Damour (one of the most expert analysts in Paris) does not find any (*Comptes Rendus*, 1862), and if any other chemists think they have done so, it would be interesting to know how they detected it. But whether there be in this stone a minute amount of metallic iron or not, it does not interfere with the statement in my first letter—viz., that the Chassigny meteorite contains even more than 75 per cent of peridote, which large amount was found by Pisani in the Ornans meteorite (July, 1868), to which I now add that no other meteoric stone hitherto (November, 1868) analysed has shown so much peridote as these two; they must, therefore, in spite of M. Meunier's contrary asssrtion, be regarded as very remarkable in this respect.

The fact alluded to also in my first letter, that meteorites which are very rich in peridote appear to have fallen without the usual striking phenomena of light, but merely accompanied with detonations, &c., will tend to confirm the opinion that this evolution of light is owing to the rapid combustion of the metallic ingredients of aërolites during their passage through our atmosphere. Hence it is hoped, as I have elsewhere shown, that the limits to which our atmosphere extends (if it has a limit) may be known some day by noting the height of shooting stars.—I am, &c.,

T. L. Phipson, Ph.D., F.C.S.

The Cedars, Putney, S.W.,
Nov. 22, 1868.

MISCELLANEOUS.

Photographic Appointment.—We have much pleasure in announcing that Mr. J. Spiller was elected Honorary Secretary of the Photographic Society, in succession to Dr. H. W. Diamond, at the meeting of council on the 17th inst. Furthermore, that he has been induced to tender his resignation of the post of Assistant Chemist in the War Department in order to accept an appointment in the Atlas Chemical Works, Hackney Wick, of which his brother, Mr. William Spiller, is part proprietor.

Reprints and New Editions.—Our attention has been drawn by Professor Pepper to a subject of some importance to scientific authors. A recent number of one of our contemporaries gives a somewhat severe review of the "Boys' Playbook of Science," the title of which designates it a "New Edition, 1869." We are informed by the author that this is simply a reprint of the old edition published ten years ago, with a new title-page, and has been issued without his revision or co-operation. This is a matter of great importance to scientific authors, as very few in the present state of science would care about their works written ten years ago being put forward and criticised as if they had been brought down to the present state of science. The result in the present case has been that Professor Pepper's work is reviewed in much more severe terms than would probably have been adopted had the writer known that he was reviewing an old book.

NOTES AND QUERIES.

Analyses of Acorns.—Perhaps the following analyses of acorns, by Dr. Voelcker, as published in the *Journal of the Royal Agricultural Society* for 1868, may suit one of your correspondents who enquires upon the subject in Notes and Queries:—

Proportions of Husk and Kernel.

Husks	13·90
Kernels	86·10
	100·00

Composition of Kernels.

Moisture	40·88
Fatty matters	2·64
Albuminous compounds (containing nitrogen 0·703)	4·39
Starch, Gum, and Sugar	46·74
Woody fibre (cellulose)	3·74
Mineral matter	1·41
	100·00

—Charles Hunter.

MEETINGS FOR THE WEEK.

Monday.—Medical, 8.
—— London Institution, 6.
—— Royal. Anniversary Meeting, 4.
Wednesday.—Society of Arts, 8. "Further Notes on the Productive Industries of Natal," by Dr. Mann.
—— Pharmaceutical, 8.
Thursday.—Chemical, 8.
Friday.—Geologists' Association, 8.

TO CORRESPONDENTS.

Messrs. Willoughby and Melmer's courteous request shall be attended to.

Elephas.—We believe it is no exaggeration to say that the excreta of one individual, by the time the sewage is appliedto the land in the way Mr. Mechi recommends, is diluted with 1,443 tons of water.

Amateur.—Heat the steel till it assumes a blue tint, and then quench in cold water.

H. Sillon.—Apply to the Secretary, Burlington House.

E. A. P.—The so-called chemical weather-glass is prepared by dissolving 2½ drachms of camphor in 11 drachms of rectified spirit; then dissolve 38 grammes each of nitre and sal-ammoniac in 9 drachms of water, and mix the whole. Place the liquid in a long tube, and carefully seal up. It is only a toy, and is of no value as a weather indicator.

Communications have been received from Professor Church; W. H. Perkin, F.R.S.; R. Tatlock; H. Walenn; Dr. E. Fleischer (with enclosure); Dr. Röhrig; Dr. C. W. Bingley; W. W. Stoddart; H. Taylor (with enclosure); Dr. T. L. Phipson (with enclosure); W. Little (with enclosure); Dr. H. Dobell; J. H. Pepper; Becker and Sons; Dr. C. Chandler (with enclosure); Dr. R. C. Moffat; Dr. R. Angus Smith, F.R.S.; Muspratt and Sons; C. F. Macdonnell; J. Primrose; J. Denby; J. Heywood; F. S. Sillitoe; and J. Maccabe.

BOOKS RECEIVED.

Report of the United States Patent Office for 1865. 3 vols. From the Honourable the Commissioner of Patents, Washington.

Electro-Metallurgy. Practically Treated by Alexander Watt. F.R.S.S.A. London: Virtue and Co.

THE CHEMICAL NEWS.

Vol. XVIII. No. 470.

POPULAR SCIENCE.

"A little learning is a dangerous thing," and the less you have the more dangerous it is. It is dangerous for a man to be so far reduced in the knowledge of fire that he cannot obtain it without the friction of sticks, because in damp weather, or in the absence of suitable wood or strength, he may be able to get none at all. But it is still more dangerous if he loses even that little knowledge without any to supply its place; he may then despair of life. If great depths were the only places where strata of valuable learning were to be found, few would benefit, as few would be found willing to leave the bright sunshine and the light of the human countenance to burrow even among treasures. We value the experience obtained by the man who sinks 2,000 feet below the surface and brings up wealth, and we listen to him with pleasure. We have a similar interest in him who leaves his home and crushes quartz in a wild place for years to obtain gold, and we look with more or less reverence on the man who hides in his study and loses society in which he delights that he may bring out of darkness what truth he can find.

All these men benefit as a rule by their labours; they have a reward independent of their discoveries: but the world cares little for their work, although accompanied by a delight in nature, or in invigorating bodily exercise, or in mental feats, compared with the great gross result itself. The gold appears and circulates; it is a part of the world's stores passing to this man and leaving that one like the air itself, and the long years of study are summed up in a few lines in a penny newspaper. The gold buys bread without the knowledge of digging and stamping, and the once abstruse discovery becomes so plain that we wonder why the student was so long about it. Having lived so many years, did he do no more than that?

There are, however, men who seem to think that the knowledge of the amalgamation process ought to come before the knowledge of the shilling's value, and are unwilling that a boy should learn a language without passing through the same process of thought passed by the nation which spoke it, forgetting the centuries of its life and its millions of living beings who modified the speech, and the few hard years which the boy has in order to attain the same end. But time teaches firmly, and throws difficulties aside by making them impossible; so we cease to enquire if the gold came from Ophir in Solomon's ships or from New Zealand by the overland route, and we learn to speak our mother tongue little thinking of the terrible history of man during the time of its formation. No student could go over the history of a piece of gold if it were in plainest language, so long would it be; or if he could read long enough he would be little endowed with feeling if he could endure it. If we saw before us all the feelings exercised in forming some of our words we should be obliged to use but few, the pain of learning would be so great.

Knowledge is real, even if the weary head that first saw it lay down in despair on account of unrewarded labour; and gold is real if the mine is lost for ever to mankind. Who knows the origin of bread-making or of pot-boiling, or of the commonest modes of agriculture? We try to form their history, and move cautiously back towards its beginning, but we soon become as thoroughly lost as when we think of the beginning of time or of space. The useful arts are conditions under which we of this generation have appeared. We heard lately of a mining company in Spain which began operations in ground covered with *débris* of previous mining and smelting operations to an extent greater than we can show in any part of this country. The old workings are said to be very extensive, and pumping Archimedean screws are still *in situ* with statuettes at cross roads, forming little chapels underground. We should like to hear more of these works and have the whole authenticated, but the heaps show already the amount of labour, and we see readily why so many vessels went to the west and why the apples themselves became to the ancients golden in such a land of wealth. The world allowed the whole to go to wreck, and believed the people to be fabulous although the golden apples were there in abundance. The one was turned almost out of tradition, the other we have multiplied to commonness, as oranges. The great world takes what it pleases of the works of men. Generations labour for centuries to elucidate a truth, and the time comes when it appears so clear as to be taught in a few minutes. The human race, with a certain majesty which we may fairly call divine, treats equally the results of a thousand years and of one day.

When philosophers think and scientific men make experiments, observations, and calculations, their work receives admiration as occasion requires, but the name is most frequently forgotten or neglected. He is highly honoured indeed who fills up a whole line in an encyclopœdia. It is true that occasionally some writer attracts the attention of the public to an individual, holding him up to the wondering world, and turning him round on all sides in a transparent biographical case, an intellectual translation of the method by which we examine bees at work in their glazed hives, astonished at the origin of their thoughts and the constancy and accuracy of their labour.

Sometimes we think it a pity that so many noble thinkers should be forgotten, but greatness is comparative. Even if our later ideas on the progress of man be incorrect, it is hard to imagine the number of men who must have given their minds to the improvement and cultivation of corn. We cannot count up the number that we have seen with our own eyes of ploughmen plodding homeward, participating in some experiment where success had been gained or was expected. As a sovereign of old who saw the people dig as one, whilst he also was one, and the more important, so tradition throws these endless agriculturists into a word and gives the honour of the discovery of corn to Ceres. We can afford under this word to give them a little amusing attention for a few hours of school days, feeling ourselves as superior to them all as a living dog to whole ages of dead lions; and why should we treat them differently? We habitually view even great worlds, suns, and systems, as objects so extremely trifling that numbers of them are required to give a slight whiteness to the sky, not visible except when the sun is absent, so trifling is the amount. We have a right to treat them all as comparatively unimportant, exactly as a child has a right to treat its nurse with more attention than any, however exalted, person that may claim its favour; an undeniable right derived from our inherent weakness and littleness. Everything in this busy world must take its place according to its value to us; we are the living dogs.

With the same absence of remorse we cut down discoveries, taking from long memoirs a few figures, and throwing the rest into a kind of waste library, which we keep out of respect for the workmen, but which we never read. The great world cares not even to keep that, but burns it virtually as it has often burnt the accumulations really. To the world the great life of an old philosopher becomes a fable. Whom shall we pick out? say Pythagoras; he is simply, to most who have heard of him, the discoverer of a geometrical problem now well known. He thanked the gods for it by a sacrifice; some of us learn it, and few remember it. The world has left but small scraps of curious and interesting things regarding all the great men of Greece, but nevertheless this is one of the most complete illustrations of the diminished influence of the great, and of the manner in which their most important ideas dwindle. Even that little is now made into abstracts. It was a wonderful thing to discover the satellites of Jupiter, but we now look at them with opera glasses, and there are even men who say that they see them with the unaided eye. When Glauber made his *sal mirabile*, finding it of wonderful power in the vegetable kingdom, in medicine, and, indeed, "to all men of whatsoever state or condition," he little thought of the hundreds of thousands of tons to be made yearly, not for direct use, but simply as a stage on the way to the manufacture of a much more important substance, *soap*. We must not bring instances here when every encyclopœdia is a proof of thousands, but we may recall to mind that sometimes the works of a man, after diminishing in magnitude to our own eyes, cease to appear altogether as discoveries, but become as simple truisms known to all men, and not to be claimed by any but quacks or adventurers. By a late treatment of Bacon's life the inductive philosophy slips from him entirely and from every other man also regarded as a founder. We still keep our respect for Bacon, but the world cares little which view is true, and probably believes after all that it would have reasoned quite as well if it had had no such training. Schools of philosophy, great for centuries, leave no trace to be seen, unless you examine the *débris* with a microscope. A few students do this and keep up the knowledge, but it gradually diminishes in their eyes, and they at last follow the example of the multitude which cares little for anything that has no rapidly available good in it. They think as the manufacturer did when an analysis was brought to him containing, among other items, a trace of sulphur. Trace! what is the use of a trace in a man's business?

As we see great things diminish into trifles or vagueness, so scientific discoveries, however much they seem for a while to fill the minds of thinking men, float lightly over the world; in other words, they become popular, and take their place at the fire-side beside the interesting fairy tale and the still more interesting bread and butter. In a certain city of no small fame, in 1848, the people determined on a revolution. They met after breakfast and stormed much, but dinner time came before they could get their work done and they went home. Of course they must dine. After dinner they required rest and a pipe and could not be collected, and so the opportunity was gone. Every event and idea interesting to man is reduced to the level of his habits, understanding, and capacity. It is made popular.

The machinery of discovery—that is, the working of the mind which discovers, is set aside, and the cream of everything is taken so far as it can be understood and fitted to man's present wants. Do not let us suppose that popular knowledge is merely a little of the least valuable; the people seize on the highest, and, for general purposes, best, and let scientific men blame themselves in most cases if their work is not known to the public. The amount of scientific work done in Europe is beyond the ken of any man. Even profound scientific men are obliged to pick out the best in a popular way; the word popular having a meaning differing according to the man. Scientific journals exist professedly to abstract the best, and reviews and newspapers extract again and make clear; that which bears explanation without long study becomes popular. No magnitude repels the public; vastness is always attractive, but complicated studies require time, and these never can become popular whether small or great in value. The people seize the best they can use, and this is popular science. We read a book of long reasoning, and forget all but a few sentences as we think, but power remains. Popular science takes these few sentences. It says, We take the kernel and leave you the shell; we burn the coal, you go down the pit; we eat, you sow.

This popular science rules us, and, to a great extent, must always guide us. When public bodies discuss affairs which require knowledge of nature, how seldom do they seek aid of scientific men? They settle by popular science. If, however, they are opposed, they seek scientific men to prove them correct, not to teach them. This brings us to the actual difference between popular science and science properly so called. Now this may be viewed in many ways, but we shall take only such as serves for present purposes. In a stagnant state popular and profound science would give the same opinion. The advantage of the latter would be in its power to give a better reason, the true place of a fact would be better known to it in its relation to other facts, but in an advancing age the thorough scientific man has a still greater advantage. He has followed the science from the beginning through a long line of learning, and he knows therefore in what direction it is leading. He knows that there are dangers on one side, uncertainties on another, and almost absolute certainty on a third. He sees to a certain extent in advance. Do not suppose that because we have looked with favour at the great position of popular science that we are inclined to speak slightingly of the true student. If we did so how foolish we should be! If the united worlds in the heavens sink down to a brightness so small as to be compared to inferior milk, it is not that we may despise, but it is rather that we may wonder more at the inconceivable distances that have produced such awful results. Nor does the world think of giving up its minuter science, but clings more and more to it, as it must find students again and again to go over the foundations of knowledge and keep up the building which has, unfortunately, in many points, been raised in the presence of a too small number of witnesses.

The popular mind knows everything in a way. No calculations trouble its serenity, no hard experiments, no long laborious readings, no weary attempts to make clear in words that which has rejoiced the heart and elevated the mind. It knows all sciences and arts, and really knows them wonderfully well. But who will trust it to do anything whatever requiring exact knowledge. If we gave it a ship to build, could it pick out good wood or make good iron? There are but few that can do the latter, even with the aid of our best metallurgical treatises. Could the popular mind put the wood or iron in a proper shape? Could it rig the ship? Could it supply it with good engines? Could it even fit up the household part with comfort? We think that there is no part whatever, from the highest pennant to the keel, that we could trust to the popular mind, even with all the grandeur with which we are inclined to believe it to be endowed. There is, probably, in every department one man only who does everything best; and, moreover, there is another man who has a better idea of improvements than any other man. In building a ship for a long voyage to bear costly bales about the world, we surely would desire the best of all these men to do the work.

In an advancing age there are always new points arising, as there are new undertakings. The whole world has become one great laboratory for experiments of various kinds. We desire to communicate with our countrymen more rapidly than by post. Popular science fails, but investigation obtains a method. This method soon becomes popular, and thousands of men know it quite well. We desire, however, to communicate with America; popular science fails, and investigation again comes, and Sir W. Thomson makes his sensitive shining needles.

Popular science is of no value in such cases; it stands aghast for a little, but it soon seems to know all about it. Popular science has, perhaps, better than real science, appreciated the practical value of that which it has adopted, but it is little able to guide civilisation rushing onwards into an unknown future, so we must be extremely careful not to allow the reins to get into her hands. In such a rapid express train as ours it is needful that there should be men carefully to examine every inch of the line, and that drivers, stokers, and guards should be multiplied rather than diminished. They must work, and their work may be very small in quantity if only compensation be made by its intrinsic excellence.

SPECTRUM OBSERVATIONS ON THE SUN.

The Rev. Father Secchi has forwarded the following communication to the French Academy of Sciences :—

" The important discovery of M. Janssen, on the possibility of seeing the luminous rays of the protuberances in full sunshine by means of the spectroscope, induced me to make some researches on this interesting subject ; and although a great part of what I have seen may become useless when we hear details from M. Janssen himself, as I may have made some new observations I take the liberty of presenting these results to the Academy.

" The spectroscope that I employed is formed of two excellent prisms of very dispersive heavy flint, and sufficiently perfect not only to double the ray D sufficiently to enable the distance between its components to be measured, but even to separate the very fine rays which are near B, towards A. The aperture of the large object glass of Merz was reduced to 8 centimetres, so as to prevent the heat injuring the apparatus ; the opening of the slit was as small as possible.

" As soon as the apparatus was directed to the sun, in such a manner that the edge of the solar image fell on the slit, I saw the rays C and F reversed—that is to say, luminous in one portion of their length across the spectrum.

" To examine in a more accurate manner the circumstances of these phenomena, I directed the slit alternately parallel and perpendicular to the edge. I then remarked that there was a reversal of the ray C very near the edge, round the entire disc of the sun ; but when the slit was perpendicular, the luminous line was from ten to fifteen seconds at most in length, except in the neighbourhood of the zones of spots and faculæ, where it was always four times as long. Many points were observed where this line appeared separated from the edge ; these points correspond, doubtless, as M. Janssen has observed, to isolated clouds. If the slit is placed parallel to the tangent of the edge, a brilliant line is seen in all parts which traverses the whole length of the spectrum, and which sometimes divides before arriving at the edge of the sun in this manner : —— – —— ; on coming nearer the edge the line becomes continuous : ————————. This observation proves that the rose coloured gaseous envelope is continuous, but very irregular in its outline, as shown by eclipses.

" The ray which appears easiest reversed is the ray C ; it dominates throughout. The ray F is also reversed, but always shorter and more feeble, as Mr. Lockyer has remarked. But what has not, I believe, been remarked before is, that near the edge of the sun, even where the ray C does not become brilliant, the black line disappears and the spectrum becomes uniform. This is not an effect of contrast, but a real phenomenon due to the reversal being only partial. The same thing is observed in the ray F and many other rays.

" Another curious fact is that the luminous lines become very vivid and brilliant in certain regions. The most remarkable are—A line in the red in contact with the ray B, on the side of C ; another at a little distance from D, at about 1½ the width of this ray on the side of the violet ; another in the green, between the two wide rays of magnesium ; finally, many others among the rays of iron.

" This augmentation of brilliancy does not appear to be due to reversal, for even with a spectroscope of seven prisms I have not seen in any of these regions a black line as large as the corresponding luminous ray. This cannot all be explained by the effect of contrast, although, indeed, this explanation is probable in the case of the green, for there a great number of the fine rays disappear near the edge. Further researches are therefore necessary, and there probably may be another explanation different from that which is usually adopted at present.

" By employing a spectroscope formed of a single very dispersive prism by Merz (with which alone all Kirchhoff's lines may be seen), I have still seen reversed the third line of hydrogen, H γ, in the violet. The black lines undergo a sensible weakening in this region near the edge. It would be premature to advance a theory, but this partial reversal may easily explain the phenomenon observed by M. Rziha, the astronomer of the Austrian Expedition, who saw that the corona gave a continuous spectrum without lines during the eclipse (*V. Astr. nach*, No. 1716).

" It may be interesting to remark that among the luminous lines observed by us are found rays near to B and D which do not belong to hydrogen, and which were seen luminous by M. Rayet. Doubtless this astronomer, owing to the feeble power of his instrument, could not notice the small space which separates them from Fraünhofer's black line.

" Thus the discovery of M. Janssen enables us to appreciate new facts, which will throw much light on many points which are still doubtful connected with this spectrum theory of the sun."

ON THE VOLUMETRIC ESTIMATION OF COMMERCIAL IODINE.

By M. ADOLPHE BOBIERRE,
Director of the Ecole Superieure des Sciences at Nantes.

In the month of May last a manufacturer consulted me concerning expeditious methods of estimating iodine. Those generally adopted, and consisting of the employment of sulphurous acid or hyposulphite of soda, yield excellent results in clever and experienced hands, but the normal liquids, whose use is necessary, vary under the influence of atmospheric oxygen. The cause of these variations has been studied by Bunsen, who further demonstrates that the estimation of iodine by sulphurous acid and starch is possible with dilute liquids only ; because if, on the one hand, the water, sulphurous acid, and iodine, may in certain cases furnish sulphuric and iodhydric acids—on the other hand, and in more concentrated liquids, the sulphuric and iodhydric acids will yield iodine and sulphurous acid.

The rapid change in the standard of sulphurous acid, the necessity of working only upon liquids of a fixed degree of concentration, and the minute precautions to be taken in order to obviate these inconveniences, made me determine, in the first instance, on rejecting this method, which, although suitable for a laboratory, may be advantageously supplanted by other processes in a manufactory. Among the ingenious methods for estimating iodine described by Streng, there is one in which protochloride of tin is employed as a reducing agent—this I do not recommend on account of the easy alteration of the reagent ; but Mohr's method, based upon the use of arsenite of soda with excess of alkali, appeared so advantageous, as regarded certainty and rapidity, that I immediately began to consider how to render its execution as simple as possible. Mohr advises that the iodine to be estimated should be pounded in a normal solution of arsenite of soda, adding a small quantity of starch ; when the whole of the iodine is combined, the liquid will be colourless, and if a normal solution of iodine be then added, the desired standard will be obtained by a relation previously established between the arsenious liquid and the iodic solution. In the hands of an experienced chemist this method is perfect, but it necessitates the use of starch, whose transformation into blue iodide is not so instantaneous as to preclude the possibility of many errors being committed by a manufacturer.

I succeeded in rapidly effecting the direct estimation of iodine in the following manner :—

I substituted for the starch reaction the intense red colour yielded by the action of free iodine upon benzine, and which was pointed out by M. Moride in 1852.

Numerous comparative experiments made by means of benzine and chloroform have clearly proved to me that the first of these liquids, from its feeble density, and the colour iodine communicates to it, is very preferable to the other.

Arsenite of soda, rendered strongly alkaline by a solution of bicarbonate of soda, receives an addition of benzine. If into this is then poured a solution of iodide of potassium containing definite quantities of iodine, it will be seen that, if these quantities vary in the following proportions—1 to ½, 1 to ⅓, 1 to ¼, 1 to ⅕—there must have been used, in order to impart a red colour to the benzine, the following divisions of iodic solution:—7·50°, 15·75°, 23·45°, 32·50°, 40·20°; quantities which are sensibly between those of 8 to 16, to 24, to 32, to 40 (1). This experiment takes only a short time, and yields, in addition to the roseate tinge of the benzine, another significant characteristic—viz., the slightly yellowish shade of the aqueous liquid. Here is the method of operation:—

Preparation of the Reagents.—Make a concentrated solution of iodide of potassium, which should remain unchanged for a certain series of experiments: this is to receive the iodine which is to be tested (2). The normal liquid arsenite of soda is obtained by combining 4·95 grs. of arsenious acid with 14·5 grs. of crystallised carbonate of soda, and diluting the aqueous liquid to 1 litre. This solution will decolourise an iodised liquid containing 12·688 grs. of iodine per litre; admitting that the arsenious liquid may not have this reducing power, the test will be none the less exact, as at the moment of effecting it the relation of a given weight of pure iodine to the arsenite will be determined.

A somewhat concentrated solution of bicarbonate of soda must now be prepared, to be used as will be shown.

Performance of the Analysis.—The analysis is best effected in a small stoppered flask, such as is generally used for hydrometric tests. Into this are put 10 c.c. of arsenite of soda, to which must be added 5 c.c. of alkaline bicarbonate solution; the whole then receives a further addition of about 4 c.c. of perfectly colourless benzine.

A given quantity of pure iodine is weighed between two watch glasses; dissolve this in the concentrated solution of iodide of potassium prepared beforehand, and which must be the same to be used for all the various estimations which may be made; fill with this coloured liquid a phial containing 100 c.c., shake it, and pour the contents into a graduated burette.

On allowing the iodised solution to fall into the arsenite drop by drop, and stirring it quickly, the brown colour will be seen to disappear instantaneously; but scarcely will the arsenite have been transformed when traces of free iodine will produce a double phenomenon; in the first place the benzine will turn red; secondly, the aqueous liquid, which was perfectly colourless at the beginning of the operation, assumes a very sensible yellowish tinge; the significant character of this is the more surprising when one comes to compute the very small quantity of metalloid which causes it. It will now be easily understood that a second experiment made upon the iodine to be estimated, the same weight being used, will instantly show the desired strength, since the volume of solution requisite to destroy the alkaline arsenite is in inverse proportion to the quantity of real iodine to be determined.

Finally, this method is simple, quick, and based upon known reactions, whose sensibility has been already proved by experience; is is therefore eminently adapted for the use of manufacturers in the estimation of commercial iodine more or less pure.—*Moniteur Scientifique.*

NOTES ON THE FOREGOING.

(1). I ought to state that it has already been proposed to substitute for the use of starch in volumetric experiments the colouring or discolouring of sulphide of carbon and of iodised chloroform (*Dupré, Annales de Chimie et de Pharmacie*, t. xciv., p. 365). M. Dupré's method, however, in no way resembles mine: it is extremely sensitive, but necessitates the employment of a solution of chlorine, while, on the other hand, the indication of the end of the operation is a discolouration. Lastly, the *Journal de Medécine de l'Ouest* of the 31st of August, 1868, contains a notice of a process by M. Bertin, which consists in dissolving the iodine to be estimated in benzine, and adding arsenite of soda until decolourisation ensues. One great advantage, in my opinion, of the process by colouring, is that the most delicate shades are perceptible, and that the tint obtained, more or less clear, will reveal the presence of sulphur in the iodine.

(2). I should have enquired whether an alcoholic solution might not be substituted for that effected by means of iodide of potassium, but I found it necessary to relinquish such a substitution. In this case part of the free iodine remains in the alcohol, which it renders yellow, to the detriment of the colouring of the benzine. This may be ascertained by adding to the alcohol a small quantity of benzine coloured red by iodine: the red colour will immediately diminish until the alcohol assumes a settled tinge of yellow.

ON A NEW SERIES OF
CHEMICAL REACTIONS PRODUCED BY LIGHT.*

By JOHN TYNDALL, LL.D., F.R.S., &c.

I ask permission of the Royal Society to draw the attention of chemists to a form or method of experiment, which, though obvious, is, I am informed, unknown, and which, I doubt not, will in their hands become a new experimental power. It consists in subjecting the vapours of volatile liquids to the action of concentrated sunlight, or to the concentrated beam of the electric light.

Action of the Electric Light.—A glass tube, 2·8 feet long and of 2·5 inches internal diameter, frequently employed in my researches on radiant heat, was supported horizontally. At one end of it was placed an electric lamp, the height and position of both being so arranged that the axis of the glass tube and that of the parallel beam issuing from the lamp were coincident. The tube in the first experiment was closed by plates of rock-salt, and subsequently by plates of glass.

As on former occasions, for the sake of distinction, I will call this tube the experimental tube.

The experimental tube was connected with an air-pump, and also with a series of drying and other tubes used for the purification of the air.

A number of test-tubes (I suppose I have used fifty of them in all) were converted into Woulfe's flasks. Each of them was stopped by a cork through which passed two glass tubes: one of these tubes (*a*) ended immediately below the cork, while the other (*b*) descended to the bottom of the flask, being drawn out at its lower end to an orifice about 0·03 of an inch in diameter. It was found necessary to coat the cork carefully with cement.

The little flask thus formed was partially filled with the liquid whose vapour was to be examined; it was then introduced into the path of the purified current of air.

The experimental tube being exhausted, and the cock which cut off the supply of purified air being cautiously turned on, the air entered the flask through the tube *b*, and escaped by the small orifice at the lower end of *b* into the liquid. Through this it bubbled, loading itself with vapour, after which the mixed air and vapour, passing from the flask by the tube *a*, entered the experimental tube, where they were subjected to the action of light.

The power of the electric beam to reveal the existence of anything within the experimental tube, or the impurities of the tube itself, is extraordinary. When the experiment is made in a darkened room, a tube which in ordinary daylight appears absolutely clean is often shown by the present mode of examination to be exceedingly filthy.

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* From the *Proceedings of the Royal Society*, No. 105, 1868.

The following are some of the results obtained with this arrangement:—

Nitrite of Amyl (boiling-point 91° to 96° C.).—The vapour of this liquid was in the first instance permitted to enter the experimental tube while the beam from the electric lamp was passing through it. Curious clouds were observed to form near the place of entry, which were afterwards whirled through the tube.

The tube being again exhausted, the mixed air and vapour were allowed to enter it in the dark. The slightly convergent beam of the electric light was then sent through the tube from end to end. For a moment the tube was optically empty—nothing whatever was seen within it; but before a second had elapsed a shower of liquid spherules was precipitated on the beam, thus generating a cloud within the tube. This cloud became denser as the light continued to act, showing at some places a vivid iridescence.

The beam of the electric lamp was now converged so as to form within the tube, between its end and the focus, a cone of rays about 8 inches long. The tube was cleansed and again filled in darkness. When the light was sent through it, the precipitation upon the beam was so rapid and intense that the cone, which a moment before was invisible, flashed suddenly forth like a solid luminous spear.

The effect was the same when the air and vapour were allowed to enter the tube in diffuse daylight. The cloud, however, which shone with such extraordinary radiance under the electric beam, was invisible in the ordinary light of the laboratory.

The quantity of mixed air and vapour within the experimental tube could of course be regulated at pleasure. The rapidity of the action diminished with the attenuation of the vapour. When, for example, the mercurial column associated with the experimental tube was depressed only 5 inches, the action was not nearly so rapid as when the tube was full. In such cases, however, it was exceedingly interesting to observe, after some seconds of waiting, a thin streamer of delicate bluish-white cloud slowly forming along the axis of the tube, and finally swelling so as to fill it.

When dry oxygen was employed to carry in the vapour, the effect was the same as that obtained with air.

When dry hydrogen was used as a vehicle, the effect was also the same.

The effect, therefore, is not due to any interaction between the vapour of the nitrite and its vehicle.

This was further demonstrated by the deportment of the vapour itself. When it was permitted to enter the experimental tube unmixed with air or any other gas, the effect was substantially the same. Hence the seat of the observed action is the vapour itself.

With reference to the air and the glass of the experimental tube, the beam employed in these experiments was perfectly cold. It had been sifted by passing it through a solution of alum, and through the thick double-convex lens of the lamp. When the unsifted beam of the lamp was employed, the effect was still the same; the obscure calorific rays did not appear to interfere with the result.

I have taken no means to determine strictly the character of the action here described, my object being simply to point out to chemists a method of experiment which reveals a new and beautiful series of reactions; to them I leave the examination of the products of decomposition. The molecule of the nitrite of amyl is shaken asunder by certain specific waves of the electric beam, forming nitric oxide and other products, of which the nitrate of amyl is probably one. The brown fumes of nitrous acid were seen to mingle with the cloud within the experimental tube.

The nitrate of amyl, being less volatile than the nitrite, could not maintain itself in the condition of vapour, but would be precipitated in liquid spherules along the track of the beam.

In the anterior portions of the tube a sifting action of the vapour occurs, which diminishes the chemical action in the posterior portions. In some experiments the precipitated cloud only extended halfway down the tube. When, under these circumstances, the lamp was shifted so as to send the beam through the other end of the tube, precipitation occurred there also.

Action of Sunlight.—The solar light also effects the decomposition of the nitrite-of-amyl vapour. On the 10th of October I partially darkened a small room at the Royal Institution, into which the sun shone, permitting the light to enter through an open portion of the window-shutter. In the track of the beam was placed a large plano-convex lens, which formed a fine convergent cone in the dust of the room behind it. The experimental tube was filled in the laboratory, covered with a black cloth, and carried into the partially darkened room. On thrusting one end of the tube into the cone of rays behind the lens, precipitation within the cone was copious and immediate. The vapour at the distant end of the tube was in part shielded by that in front, and was also more feebly acted on through the divergence of the rays. On reversing the tube, a second and similar cone was precipitated.

Physical Considerations.—I sought to determine the particular portion of the white beam which produced the foregoing effects. When, previous to entering the experimental tube, the beam was caused to pass through a red glass, the effect was greatly weakened, but not extinguised. This was also the case with various samples of yellow glass. A blue glass being introduced, before the removal of the yellow or the red, on taking the latter away, augmented precipitation occurred along the track of the blue beam. Hence, in this case, the more refrangible rays are the most chemically active.

The colour of the liquid nitrite of amyl indicates that this must be the case; it is a feeble but distinct yellow; in other words, the yellow portion of the beam is most freely transmitted. It is not, however, the transmitted portion of any beam which produces chemical action, but the absorbed portion. Blue, as the complementary colour to yellow, is here absorbed, and hence the more energetic action of the blue rays. This reasoning, however, assumes that the same rays are absorbed by the liquid and its vapour.

A solution of the yellow chromate of potash, the colour of which may be made almost, if not altogether, identical with that of the liquid nitrite of amyl, was found far more effective in stopping the chemical rays than either the red or the yellow glass. But of all substances the nitrite itself is most potent in arresting the rays which act upon its vapour. A layer one-eighth of an inch in thickness, which scarcely perceptibly affected the luminous intensity, sufficed to absorb the entire chemical energy of the concentrated beam of the electric light.

The close relation subsisting between a liquid and its vapour, as regards their action upon radiant heat, has been already amply demonstrated.* As regards the nitrite of amyl, this relation is more specific than in the cases hitherto adduced; for here the special constituent of the beam which provokes the decomposition of the vapour is shown to be arrested by the liquid.

A question of extreme importance in molecular physics here arises:—What is the real mechanism of this absorption, and where is its seat?†

I figure, as others do, a molecule as a group of atoms, held together by their mutual forces, but still capable of motion among themselves. The vapour of the nitrite of amyl is to be regarded as an assemblage of such molecules. The question now before us is this:—In the act of absorption, is it the molecules that are effective, or is it their constituent atoms? Is the *vis viva* of the intercepted waves transferred to the molecule as a whole, or to its constituent parts?

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* *Phil. Trans.*, 1864.

† My attention was very forcibly directed to this subject some years ago by a conversation with my excellent friend Professor Clausius.

The molecule, as a whole, can only vibrate in virtue of the forces exerted between it and its neighbour molecules. The intensity of these forces, and consequently the rate of vibration, would, in this case, be a function of the distance between the molecules. Now the identical absorption of the liquid and of the vaporous nitrite of amyl indicates an identical vibrating period on the part of liquid and vapour, and this, to my mind, amounts to an experimental demonstration that the absorption occurs in the main within the molecule. For it can hardly be supposed, if the absorption were the act of the molecule as a whole, that it could continue to affect waves of the same period after the substance had passed from the vaporous to the liquid state.

In point of fact, the decomposition of the nitrite of amyl is itself to some extent an illustration of this internal molecular absorption; for were the absorption the act of the molecule as a whole, the relative motions of its constituent atoms would remain unchanged, and there would be no mechanical cause for their separation. It is probably the synchronism of the vibrations of one portion of the molecule with the incident waves which enables the amplitude of those vibrations to augment until the chain which binds the parts of the molecule together is snapped asunder.

The liquid nitrite of amyl is probably also decomposed by light; but the reaction, if it exists, is incomparably less rapid and distinct than that of the vapour. Nitrite of amyl has been subjected to the concentrated solar rays until it boiled, and it has been permitted to continue boiling for a considerable time, without any distinctly apparent change occurring in the liquid.[*]

I anticipate wide, if not entire, generality for the fact that a liquid and its vapour absorb the same rays. A cell of liquid chlorine now preparing for me will, I imagine, deprive light more effectually of its power of causing chlorine and hydrogen to combine than any other filter of the luminous rays. The rays which give chlorine its colour have nothing to do with this combination, those that are absorbed by the chlorine being the really effective rays. A highly sensitive bulb, containing chlorine and hydrogen in the exact proportions necessary for the formation of hydrochloric acid was placed at one end of the experimental tube, the beam of the electric lamp being sent through it from the other. The bulb did not explode when the tube was filled with chlorine, while the explosion was violent and immediate when the tube was filled with air. I anticipate for the liquid chlorine an action similar to, but still more energetic, than that exhibited by the gas. If this should prove to be the case, it will favour the view that chlorine itself is molecular and not monatomic. Other cases of this kind I hope, at no distant day, to bring before the Royal Society.

Production of Sky-blue by the decomposition of Nitrite of Amyl.—When the quantity of nitrite vapour is considerable, and the light intense, the chemical action is exceedingly rapid, the particles precipitated being so large as to whiten the luminous beam. Not so, however, when a well-mixed and highly-attenuated vapour fills the experimental tube. The effect now to be described was obtained in the greatest perfection when the vapour of the nitrite was derived from a residue of the moisture of its liquid, which had been accidentally introduced into the passage through which the dry air flowed into the experimental tube.

In this case the electric beam traversed the tube for several seconds before any action was visible. Decomposition then visibly commenced, and advanced slowly. The particles first precipitated were too small to be distinguished by an eye-glass; and, when the light was very strong, the cloud appeared of a milky blue. When, on the contrary, the intensity was moderate, the blue was pure and deep. In Brücke's important experiments on the blue of the sky and the morning and evening red, pure mastic is dissolved in alcohol, and then dropped into water well stirred. When the proportion of mastic to alcohol is correct, the resin is precipitated so finely as to elude the highest microscopic power. By reflected light, such a medium appears bluish, by transmitted light yellowish, which latter colour, by augmenting the quantity of the precipitate, can be caused to pass into orange or red.

But the development of colour in the attenuated nitrite-of-amyl vapour, though admitting of the same explanation, is, doubtless, more similar to what takes place in our atmosphere. The blue, moreover, is purer and more sky-like than that obtained from Brücke's turbid medium. There could scarcely be a more impressive illustration of Newton's mode of regarding the generation of the colour of the firmament than that here exhibited; for never, even in the skies of the Alps, have I seen a richer or a purer blue than that attainable by a suitable disposition of the light falling upon the precipitated vapour. May not the aqueous vapour of our atmosphere act in a similar manner? and may we not fairly refer to liquid particles of infinitesimal size the hues observed by Principal Forbes over the safety-valve of a locomotive, and so skilfully connected by him with the colours of the sky?

In exhausting the tube containing the mixed air and nitrite-of-amyl vapour, it was difficult to avoid explosions under the pistons of the air-pump similar to those which I have already described as occurring with the vapours of bisulphide of carbon and other substances. Though the quantity of vapour present in these cases must have been infinitesimal, its explosion was sufficient to destroy the valves of the pump.

Iodide of Allyl (boiling-point 101° C.).—Among the liquids hitherto subjected to the concentrated electric light, iodide of allyl, in point of rapidity and intensity of action, comes next to the nitrite of amyl. With the iodide of allyl I have employed both oxygen and hydrogen, as well as air, as a vehicle, and found the effect in all cases substantially the same. The cloud column here was exquisitely beautiful, but its forms were different from those of the nitrite of amyl. The whole column revolved round the axis of the decomposing beam; it was nipped at certain places like an hour-glass, and round the two bells of the glass delicate cloud-filaments twisted themselves in spirals. It also folded itself into convolutions resembling those of shells. In certain conditions of the atmosphere in the Alps I have often observed clouds of a special pearly lustre; when hydrogen was made the vehicle of the iodide-of-allyl vapour, a similar lustre was most exquisitely shown. With a suitable disposition of the light, the purple hue of iodine vapour came out very strongly in the tube.

The remark already made, as to the bearing of the decomposition of nitrite of amyl by light on the question of molecular absorption, applies here also; for were the absorption the work of the molecule as a whole, the iodine would not be dislodged from the allyl with which it is combined. The non-synchronism of iodine with the waves of obscure heat is illustrated by its marvellous transparency to such heat. May not its synchronism with the waves of light in the present instance be the cause of its divorce from the allyl? Further experiments on this point are in preparation.

Iodide of Isopropyl.—The action of light upon the vapour of this liquid is at first more languid than upon iodide of allyl; indeed many beautiful reactions may be overlooked in consequence of this languor at the commencement. After some minutes' exposure, however, clouds begin to form, which grow in density and in beauty as the light continues to act. In every experiment hitherto made with this substance the column of cloud which filled the experimental tube was divided into two distinct parts near the middle of the tube. In one experiment, a globe of cloud formed at the centre, from which, right and left, issued an axis which united the globe with the two adjacent cylinders. Both globe and cylinders were animated by a common motion of rotation. As the action continued, paroxysms of motion were manifested; the various parts of the cloud would rush through each other with sudden violence. During these motions beautiful and grotesque cloud-forms were developed. At some places the nebulous mass would become ribbed so as to resemble the graining of wood; a longitudinal motion would at times generate in it a series of curved transverse bands, the retarding influence of the sides of the tube causing an appearance resembling, on a small scale, the dirt-bands of the Mer de Glace. In the anterior portion of the tube those sudden commotions were most intense; here buds of cloud would sprout forth, and grow in a few seconds into perfect flower-like forms. The most curious appearance that I noticed was that of a cloud resembling a serpent's head: it grew rapidly; a mouth was formed, and from the mouth a cord of cloud resembling a tongue was rapidly discharged. The cloud of iodide of isopropyl had a character of its own, and differed materially from all others that I had seen. A gorgeous mauve colour was developed in the last twelve inches of the tube; the vapour of iodine was present, and it may have been the sky-blue produced by the precipitated particles which, mingling with the purple of the iodine, produced this splendid mauve. As in all other cases here adduced, the effects were proved to be due to the light; they never occurred in darkness.

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[*] On the 21st of October, Mr. Ernest Chapman mentioned to me in conversation that he once exposed nitrite-of-amyl vapour to the action of light. With what result I do not know.

I should like to guard myself against saying more than the facts warrant regarding the chemical effects produced by light in the following three substances; but the physical appearances are so exceedingly singular that I do not hesitate to describe them.

Hydrobromic Acid.—The aqueous solution of this acid was placed in a small Woulfe's flask, and carried into the experimental tube by a current of air.

The tube being filled with the mixture of acid, aqueous vapour, and air, the beam was sent through it, the lens at the same time being so placed as to produce a cone of very intense light. Two minutes elapsed before anything was visible; but at the end of this time a faint bluish cloud appeared to hang itself on the most concentrated portion of the beam.

Soon afterwards a second cloud was formed five inches further down the experimental tube. Both clouds were united by a slender cord of cloud of the same bluish tint as themselves.

As the action of the light continued, the first cloud gradually resolved itself into a series of parallel discs of exquisite delicacy; the discs rotated round an axis perpendicular to their surfaces, and finally they blended together to produce a screw surface with an inclined generatrix. This surface gradually changed into a filmy funnel, from the end of which the "cord" extended to the cloud in advance. This also underwent modification. It resolved itself into a series of strata resembling those of the electric discharge. After a little time, and through changes which it was difficult to follow, both clouds presented the appearance of a series of concentric funnels set one within the other, the interior ones being seen through the spectral walls of the outer ones; those of the distant cloud resembled claret glasses in shape. As many as six funnels were thus concentrically set together, the two series being united by the delicate cord of cloud already referred to. Other cords and slender tubes were afterwards formed, and they coiled themselves in spirals around and along the funnels.

Rendering the light along the connecting cord more intense, it diminished in thickness and became whiter; this was a consequence of the enlargement of its particles. The cord finally disappeared, while the funnels melted into two ghost-like films, shaped like parasols. The films were barely visible, being of an exceedingly delicate blue tint; they seemed woven of blue air. To compare them with cobweb or with gauze would be to liken them to something infinitely grosser than themselves.

In a second trial the result was very much the same. A cloud which soon assumed the parasol shape was formed in front, and 5 inches lower down another cloud was formed, in which the funnels already referred to were considerably sharpened. It was connected as before by a filament with the cloud in front, and it ended in a spear-point which extended 12 inches further down the tube.

After many changes, the film in front assumed the shape of a bell, to the convex surface of which a hollow cylinder about 2 inches long attached itself. After some time this cylinder broke away from the bell and formed itself into an iridescent ring, which, without apparent connection with anything else, rotated on its axis in the middle of the tube. The inner diameter of this ring was nearly an inch in length, and its outer diameter nearly an inch and a half.

The whole cloud composed of these heterogeneous parts was animated throughout by a motion of rotation. The rapidity of the rotation could be augmented by intensifying the beam. The disks, funnels, strata, and convolutions of the cloud exhibited at times diffraction colours, which changed colour with every motion of the observer's eye.

Moisture appeared to be favourable to the production of these appearances; and it hence became a question how far they were really produced by the light: hydrobromic acid, even from its solution, fumes when it comes into contact with the aqueous vapour of the air; its residence in water does not appear to satisfy its appetite for the liquid. The same effect, as everybody knows, is observed in the solution of hydrochloric acid. Might not, then, those wonderfully-shaped clouds be produced by an action of this kind, the presence of the light being an unnecessary accident?

The hydrobromic acid was permitted to enter the experimental tube and remain in diffuse daylight for five minutes. On darkening the room and sending the electric beam through it, the tube was optically empty. Two minutes' action of the light caused the clouds to appear, and they afterwards went through the same variety of changes as before.

No matter how long the hydrobromic acid was allowed to remain in the tube, no action occurred until the luminous beam was brought into play. The tube filled with the mixture of air, aqueous vapour, and hydrobromic acid was permitted to remain for fifteen minutes in the dark. On sending the beam through the tube, it was found optically empty; but two minutes' action of the light developed the clouds as before.

Permitting the beam to pass through a layer of water before entering the experimental tube, no diminution of its chemical energy was observed. Permitting it to pass through a solution of hydrobromic acid, of the same thickness, the chemical energy of the beam was wholly destroyed. This shows that the vibrations of the dissolved acid are synchronous with those of the gaseous acid, and is a new proof that the constituent atoms of the molecule, and not the molecule itself, is the seat of the absorption.

Hydrochloric Acid.—The aqueous solution of this acid was also employed and treated like the solution of hydrobromic acid. I intend to invoke the aid of an artistic friend in an effort to reproduce the effects observed during the decomposition, if such it be, of hydrochloric acid by light. But artistic skill must, I fear, fail to convey a notion of them. The cloud was of slow growth, requiring fifteen or twenty minutes for its full development. It was then divided into four or five sections, every adjacent two of which were united by a slender axial cord. Each of these sections possessed an exceedingly complex and ornate structure, exhibiting ribs, spears, funnels, leaves, involved scrolls, and iridescent fleurs-de-lis. Still the structure of the cloud from beginning to end was perfectly symmetrical; it was a cloud of revolution, its corresponding points being at equal distances from the axis of the beam. There are many points of resemblance between the clouds of hydrochloric and hydrobromic acid, and both are perfectly distinct from anything obtainable from the substances previously mentioned; in fact, every liquid appears to have its own special cloud, varying only within narrow limits from a normal type. The formation of the cloud depends rather upon its own inherent forces than upon the environment. It is true that, by warming or chilling the experimental tube at certain points, extraordinary flexures and whirlwinds may be produced; but with a perfectly constant condition of tube, specific differences of cloud-structure are revealed, the peculiarity of each substance stamping itself apparently upon the precipitated vapour derived from its decomposition.

When the beam before entering the experimental tube was sent through a layer of the aqueous acid, thirteen minutes' exposure produced no action. A layer of water being substituted for the layer of acid, one minute's exposure sufficed to set up the decomposition.

Hydriodic Acid.—The aqueous solution of this acid was also employed. On first subjecting it to the action of light no visible effect was produced; but subsequent trials developed a very extraordinary one. A family resemblance pervades the nebulæ of hydriodic, hydrobromic, and hydrochloric acids. In all three cases, for example, the action commenced by the formation of two small clouds united by a cord; it was very slow, and the growth of the cloud in density and beauty very gradual. The most vivid green and crimson that I have yet observed were exhibited by this substance in the earlier stages of the action. The development of the cloud was like that of an organism, from a more or less formless mass at the commencement, to a structure of marvellous complexity. I have seen nothing so astonishing as the effect obtained, on the 28th of October, with hydriodic acid. The cloud extended for about 18 inches along the tube, and gradually shifted its position from the end nearest the lamp to the most distant end. The portion quitted by the cloud proper was filled by an amorphous haze, the decomposition which was progressing lower down being here apparently complete. A spectral cone turned its apex towards the distant end of the tube, and from its circular base filmy drapery seemed to fall. Placed on the base of the cone was an exquisite vase, from the interior of which sprung another vase of similar shape; over the edges of these vases fell the faintest clouds, resembling spectral sheets of liquid. From the centre of the upper vase a straight cord of cloud passed for some distance along the axis of the experimental tube, and at each side of this cord two involved and highly iridescent vortices were generated. The frontal portion of the cloud, which the cord penetrated, assumed in succession the forms of roses, tulips, and sunflowers. It also passed through the appearance of a series of beautifully shaped bottles placed one within the other. Once it presented the shape of a fish, with eyes, gills, and feelers. The light was suspended for several minutes, and the tube and its cloud permitted to remain undisturbed in darkness. On re-igniting the lamp, the cloud was seen apparently motionless within the tube; much of its colour had gone, but its beauty of form was unimpaired. Many of its parts were calculated to remind one of Gassiot's discharges; but in complexity, and, indeed, in beauty, the discharges would not bear comparison with these arrangements of cloud. A friend to whom I showed the cloud likened it to one of those jelly-like marine organisms which a film barely capable of reflecting the light renders visible. Indeed no other comparison is so suitable; and not only did the perfect symmetry of the exterior suggest this idea, but the exquisite casing and folding of film within film suggested the internal economy of a highly complex organism. The twoness of the animal form was displayed throughout, and no coil, disc, or speck existed on one side of the axis of the tube that had not its exact counterpart at an equal distance on the other. I looked in wonder at this extraordinary production for nearly two hours.[*]

The precise conditions necessary to render the production of the effects observed with hydrobromic, hydrochloric, and hydriodic acids a certainty have not yet been determined. Air, moreover, is the only vehicle which has been employed here. I hazard no opinion as to the chemical nature of these reactions. The dry acids, moreover, I have not yet examined.

NOTICES OF BOOKS.

Letters on Natural Magic. By Sir DAVID BREWSTER. New Edition. Edited by J. A. Smith. London: William Tegg. 1868.

THE notice of this volume has been purposely delayed for some weeks; the reasons for this will be apparent after an analysis of the book itself.

Viewing it, as we reasonably may, from its scriptural quotations and high moral tone, as a scientific sermon, our remarks (as suggested by this view of the case), may be arranged under three heads, with an application.

1st. Physical and naked eye characters of the present edition. 2nd. The editor's aim and results in his own language as nearly as may be. 3rd. A common-sense and rational view of these results, and of the author's arguments; this, it is hardly necessary to state, is synonymous with the opinion of the reviewer, and, we hope, of the readers of the CHEMICAL NEWS; the application will show the importance of the whole of the questions involved in the above.

1st. The volume consists of a new edition of the "Letters on Natural Magic" addressed to Sir Walter Scott by Sir David Brewster, some general remarks (physical and metaphysical), and the latest edition of the explanations of more recent natural magic tricks; the whole of these are added by Mr. J. A. Smith, author of a treatise "On the Structure of Matter." The book, called "Brewster's Natural Magic" (*vide* back of volume), contains—a preface (Mr. Smith); a first part, on the being and faculties of man in reference to natural magic, by Mr. Smith (86 pages); Sir David's original letters (306 pages); 32 additional ones for explaining the phenomena of natural magic not treated of by Sir David Brewster, so in default by Mr. Smith. Thus Mr. Smith writes one-fourth of the book, explaining, reconciling, and harmonising all known truth and facts, with poor Sir David Brewster between its component one-eighths like a valley between two hills.

Of Sir David's original letters it is unnecessary to speak—they belong to our scientific classics; and we are sincerely grateful to Mr. Smith for not having removed objectionable passages to an appendix, as the wont of editors of classics is.

2nd. Mr. Smith's preface tells us his aims and results. *Object:* as credulity is great, it is desirable to get rid of it; the *means* used by him are the giving to letters that Sir Walter Scott delighted in "the benefit of that profounder interest which must arise from a consideration of the physical and metaphysical existence of man." This method of adding to the interest of a subject we hope shortly to see applied to "Johnson's Dictionary," the "Arabian Nights," and "Newton's Principia"—all of them classical books. To Mr. Smith, above all editors, should the first-named volume be thus handed for his corrections, for how is credulity defined by him?—"the extreme of scepticism is credulity, and the extreme of credulity or superstition is scepticism;" "the words are used in a philosophic sense merely." Thus on the threshold the charitable allowance made by a scientific man for a person who attaches only a Pickwickian sense to the words he uses, cannot be allowed here.

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[*] "It is as perfect as if turned in a lathe;" "It would prove exceedingly valuable to pattern-designers," were remarks made by my assistants as they watched the experiment. Mr. Ladd, who is intimately acquainted with the phenomena of the electric discharge through rarefied media, remarked that no effect he had ever seen could compete in point of beauty and complexity with the appearance here imperfectly described. I mention this to indicate how the phenomena affected other eyes than mine.

Statements of the editor, taken at random, made by him with the above-mentioned object. *Man.*—"Three-fourths of his whole being is metaphysical or immaterial, and only one-fourth, and that the least essential portion of it, his body, physical or material." "Matter may exist without life, mind, or feeling; it is hence reciprocally inferrible that life, mind, and feeling may all exist in a state of separation from matter." The very foundation of many disputed questions is thus easily disposed of by reciprocal inference; we presume that this expression is used in a philosophic sense merely.

"In the experience of every man, our consciousness did not exist from all eternity"—"even matter did not always exist to man's consciousness; hence the indestructibility of matter is not demonstrable by so limited and finite a being as man." Force is consistently ignored; thus, "electricity is a material element, capable by its application of expanding and contracting bodies, as electrolysis has shown." Immaterials "float along our nerves and tissues by a mysterious power and range of volition." Chemical forces certainly don't act in this sort of way. "Beila's comet," in 1846, without any ascertainable cause, divided into two parts—the division continues: this demonstrates that "there are conditions in which matter may not be possessed either of cohesion or concentric attractions—a circumstance which no known law of chemistry or other science can explain." We will gradually reach a climax with Mr. Smith. "Feeling and taste have *actual* contact, and the perception of temperature, and the sense of smell, *partial* contact, and *partial* perception of temperature, in addition to," &c. Thus Mr. Smith smells the variations of temperature because cold makes him sneeze!

We are told sensation does not run up nerves, but Consciousness runs down them; when a man cuts his finger, he cuts the immaterial Consciousness: the experiment is suggested of putting an animal under the influence of chloroform, tickling its leg to get the Consciousness into it, and then removing both together (p. 31).

There is a great deal of scripture quoted in the book; but we were amazed at the discussion (p. 55) of the manner in which the Deity is influenced by rays of light.

We would commend to Mr. Smith the following remarks of the great Addison. After remarking that the Jews would not let a name so great (given by Mr. Smith in the text) enter even into their religious discourses, he says, "What can we then think of those who admit it into the most familiar questions and assertions, ludicrous phrases, and works of humour."

Mr. Smith tells us that "to human optics the source of sight is not even the object seen, but the original influence of light, which, falling upon objects, and picking up their images by the way, carries those images as an incidence to our consciousness; for the incident rays of optical science, after all, are not those rays which, reflected from a mirroring surface, form what we otherwise call deflected rays, but those rays of light which, falling on incidental objects in their course, make the limits and peculiarties of these objects their first mirror or imaging surface, and from mirrors purely so called pick up nothing, but merely suffer additional or further and renewed deflection, and bear with them thence, and still unimpaired, the first image they have acquired in their progress from originally pure light. This is probably not the mode in which a disengaged consciousness, freed from the eye and its optical arrangements, and in actual contact with objects, would perceive them—not the way in which a spirit, or in which God perceives objects."

The author has expressly stated, as we have shown, that electricity is a material element; at p. 64 we are told "it is impossible to perceive how life, which is not a physical element, can be a physical force." Influenced by such arguments (p. 70), it is concluded that all we can say of metaphysics is—"that IT IS; and then sink our vaunted knowledge into lip-sealed and humbled ignorance."

The expression of our author at p. 59—"*Nil nisi bonus mortis*"—may be a metaphysical reading of a rather trite quotation; physically read, the Latin is decidedly ungrammatical.

Leaving metaphysics, let us see what are found to be additional phenomena of natural magic; a short list will suffice:—"Professor Pepper's Ghost," "Facts beyond the range of Physics," "Herr Frikel's Masks and Faces," "Floating Cherubs," "Aurora Borealis," "New Fact in Philosophy," the latter discovered by Mr. Smith. By facts, the editor of the book leads us to a *reductio ad absurdum* in the case of the two theories—"*ex nihilo nihil fit*," and 2 + 2 always equal 4—just as Euclid would treat any proposition equally absurd with them; but the method is by applying natural history to chemistry, or *vice versâ*, as convenient. Two sovereigns don't always equal one and another one, because one Amœba may be cut into three or four; so on *ad nauseam*: people who make contrary statements are ignorant of any science but their own. Mr. Smith says—"Among modern philosophers (who have ideas of fixity) we never have found one who had a wide knowledge of comparative science." A chemist is silenced by a child in an imaginary conversation:—*Child*—"What is gold made of?" *Chemist*—"It is a primary element my dear—nothing but gold." Question and answer repeated. *Child*—"But gold must be made of something. *Chemical parent* (silenced) has to divert the child's mind; not that this results from the child's want of capacity—oh no!—"it is the honest energy of unvitiated dialectics penetrating to the legitimate ultimatum of all causation."

Thirdly, we sum up the whole question. It is hardly worth while to inquire which is weakest—Mr. Smith's Latin, physics, physiology, or zoology; which of Mr. Dickens's characters are more prominently suggested to us for purposes of comparison—Pogram, who got out of his depth instantly, or the three L.L's, who were never in theirs—in their famous metaphysical discussion. But there is a serious side to the subject. Not one person in ten reads a preface, and without a clear understanding of the arrangement of the book, and a pre-existent knowledge of Sir David Brewster's style, his high authority would be accepted for the utterances of—Mr. Smith. Imagine Sir David Brewster, in a letter to Sir Walter Scott, discussing the manner in which the Deity perceives rays of light! We cannot protest too strongly against incompetent editorship of a scientific classic; how much more when the volume is meant for general readers, who will be impressed with the weakness of argument used by scientific men presumptively represented by Sir David Brewster. We deny the right of any metaphysical philosopher to use scientific property (as the letters are) as an advertisement for his own vague ideas, which would be otherwise ignored by science.

"*Elements of Chemistry, Theoretical and Practical. Part II., Inorganic Chemistry.*" By William Allen Miller, M.D., LL.D., V.P.R.S. London: Longmans, Green, Reader, and Dyer, 1868.

This fourth edition of Dr. Miller's classical elements cannot fail to increase its reputation for accuracy and for keeping up with the latest progress of science. We shall notice a few points as in duty bound; but must in the first place emphatically record the verdict that the work, as it always has been from its first appearance, is unrivalled for the amount of information contained in, comparatively speaking, a small space, without serious loss from condensation of its matter. Among English chemical classics, it is second only to Watts's "Dictionary," which is too vast a work for one author, and cannot fairly be compared with the "Elements" in this respect.

The plan of the book has been unaltered, and we hope it may never be so to any great extent, but a few matters we think might take their place more easily, by transference from the third to the second part.

Among minor matters, we scarcely understand why the expression "cupreous" (oxide, chloride, &c.), should be preferred to cuprous; we have sulphurous in chemistry, the expression sulphureous being, we believe, limited to "Paradise Lost," and old books generally.

The greatest pains to secure an inclusion of the latest matter is shown throughout the book, notably in two respects. The researches of Roscoe on Vanadium are accurately set forth, and compared with those of Berzelius, a very interesting summary is the result, and we would call our readers' attention to the matter. In Dr. Miller's list of elements, Roscoe's equivalent number is preferred to that of Berzelius, but the theoretical plan claimed by Dr. Roscoe is not allowed: Vanadium is not only not placed in the nitrogen family, but it is excluded even from the elements called triads. Its claim to this position is surely as strong as that of chromium or manganese to the hexad, or of iron to the tetrad group.

Another most interesting paper is also given to us in a concentrated form, relating to chemical change in solution—we allude to the papers of Messrs. Harcourt and Esson—which from their philosophic accuracy of detail well merit a careful study.

It may be observed, in passing, that Dr. Miller generally gives references to the original sources from whence he obtains the information he gives us; this is a valuable feature of the work, and the future value will be still further increased by an extension of this principle of giving references to the sources where full information may be obtained. It is true that all these may be found in Watts's "Dictionary," but they would also be useful here for the student, who has not always ready access to that work; we urge this chiefly on behalf of such students.

We hope that a too rigid method of adhering to the plan of arrangement of the three volumes will not limit the usefulness of each separate volume; a little repetition of matter is often necessary, and no one is more qualified than Dr. Miller to give us the characteristic spectroscopic tests of metals, &c., which may fairly be placed side by side with specific gravity and conducting power in the physical history of each element or compound.

One of our favourite sections in the second part we are pleased to find added to, and made more interesting—we allude to the section treating of the equivalent weights of the elements as given by different authors, and their different processes. The use of the new expression in the present edition of non-metals as opposed to metals, gives, we hope, the death-blow to that word of exotic growth "metalloids."

In conclusion, we congratulate Dr. Miller upon his success in improving the work that has always been one of the chemists' best and most intimate friends.

CORRESPONDENCE.

PERIDOTE METEORS.

To the Editor of the Chemical News.

Sir,—I am surprised to see that Dr. Phipson, who has lately published such an interesting work on meteorites, considers the stone of Chassigny as a solitary exception; as I have already said, in my letter published in No. 468 of your valuable journal, other meteorites, such as those of Luotalaks, Finland (December 13, 1823), of Bralystock, Poland (October 5 or 8, 1827), and of Massing, Bavaria (December 13, 1803), offer a composition perfectly analogous.

It will suffice, I think, to justify my assertion, to recall, for example, the results obtained by Berzelius (Poggendorff's *Annalen*, vol. xxxiii., p. 90) in analysing the stone of Luotalaks, and to compare them with those of the well-conducted experiments made by Mr. Damour on the stone of Chassigny.

The stone of Luotalaks contains 93·63 per cent of matter attackable by acids, and offering the same composition as the analogous substance which forms the 96·23 hundredths of the stone of Chassigny. In the following table the first column contains the numbers relating to the peridote of Luotalaks, and the second those which relate to the peridote of Chassigny:—

	Peridote, forming 93·63 per cent of the stone of Luotalaks.	Peridote, forming 96·23 per cent of the stone of Chassigny.
Silica..	37·4111	36·83
Magnesia..	32·9220	33·15
Protoxide of iron	28·6100	27·93
Protoxide of manganese	0·7930	0·55
Alumina	0·2640	0·55
Sesquioxide of chromium	0·2640	0·85
Potash	trace	0·69
Soda	trace	0·69
	100·00	100·00

The stones of Bralystock and of Massing give analogous results. Consequently Dr. Phipson has no authority for saying that "no other meteoric stone hitherto (Nov., 1868) analysed has shown so much peridote as these two" (Chassigny and Ornans).—I am, &c.,

Stanislas Meunier,
Aide Naturaliste au Museum.

33, Rue de Vaugirard, Paris.

COHESION FIGURES.

To the Editor of the Chemical News.

Sir,—Your last issue contains a letter from Mr. J. Emerson Reynolds, on cohesion figures. In it is stated that he was enabled to exhibit these on the ceiling, by means of the oxyhydrogen lamp, to the members of the Dublin Society on the 16th inst. If I have not been wrongly informed, Dr. Strethill Wright did the same (but on a large screen) upwards of three years ago, at a meeting of the Royal Scottish Society of Arts held in Edinburgh. I was not present at Dr. Wright's lecture, but I was informed by several scientific friends of his having very successfully done so.

In my private communication to you on the 20th inst., I stated that I had been able to fix the beautiful patterns produced by different oils when placed on water in colours on paper. I have been successful in transferring to simple paper the many forms of crochet-like patterns assumed by various oils, and of imbuing the paper with any colour, such as scarlet, black, &c. Those I enclosed to you were scarlet patterns of rape oil, fixed at different periods of time within the sixty seconds. Our process is one of great simplicity and beauty, and as many as a dozen copies may be taken off, at intervals within the minute, by employing that number of large glass basins filled with water. I fancy they might readily be photographed while being developed, but that department I have not gone into. Mr. Reynolds deserves credit for bringing this beautiful mode of ascertaining the relative purity of oils (though it is only an excellent conjunctive test) before his meeting in Dublin. Some little time will elapse before I complete my experiments, as I intend to place the slips of paper containing the coloured patterns on the pages of books, so that they may be retained for reference by chemists, oil refiners, &c. It is well known that Tomlinson was the first to bring into public notice the cohesion figures of oils on water; and all I claim is the fixing of these figures in colours on paper. In the meantime, should any chemist desire the paper patterns, or the figures of particular oils, I shall be most happy to forward them, though they will necessarily be in an unfinished condition.—I am, &c.,

R. Carter Moffat, Ph.D.

Laboratory, Mechanics' Institution, Glasgow.
Nov. 29th, 1868.

MISCELLANEOUS.

The Royal Society.—At the annual meeting of the Fellows of this Society on Monday last (St. Andrew's day), the gold medals of the Society were awarded as follows:—The Copley to Sir Charles Wheatstone, D.C.L., Oxon., Professor of Experimental Philosophy, King's College, London; the Romford medal to Dr. Balfour Steward, M.A., Superintendent of the Kew Observatory of the British Association. Of the two Royal medals, one was awarded to the Rev. Dr. Salmon, Regius Professor of Divinity in the University, Dublin; and the other to Mr. Alfred Russell Wallace, well known by his researches in the zoology of the Eastern Archipelago. At the same meeting, the following officers and council were elected for the ensuing year:—*President*, Lieut.-General Edward Sabine, R.A., D.C.L., LL.D. *Treasurer*, William Allen Miller, M.D., LL.D. *Secretaries*, William Sharpey, M.D., LL.D., George Gabriel Stokes, Esq., M.A. D.C.L., LL.D. *Foreign Secretary*, Professor William Hallows Miller, M.A., LL.D. *Other Members of the Council*, Frederick Augustus Abel, Esq., Sir Benjamin Collins Brodie, Bart., M.A., William Benjamin Carpenter, M.D., J. Lockhart Clarke, Esq., Frederick Currey, Esq., M.A., Warren De La Rue, Esq., Ph.D., Sir William Fergusson, Bart., William Henry Flower, Esq., Captain Douglas Galton, C.B., John Peter Gassiot, Esq., John Hawkshaw, Esq., John Marshall, Esq., Joseph Prestwich, Esq., George Henry Richards, Capt. R.N., Archibald Smith, Esq., M.A., Lieut.-Colonel Alexander Strange.

Royal Institution of Great Britain.—Friday Evening Arrangements.—Jan. 15th. Professor Tyndall, F.R.S., M.R.I., "On Chemical Rays and Molecules." Jan. 22nd. Professor Alexander Herschel, "On the last Eclipse of the Sun." Jan. 29th. John Ruskin, Esq., "On the Flamboyant Architecture of the Valley of the Somme." Feb. 5th. James Fergusson, Esq., F.R.S., "Tree and Serpent Worship, as exemplified by recently-discovered Indian Monuments." Feb. 12th. Colonel W. F. Drummond Jervois, "On the Coast Defences of England." Feb. 19th. C. Greville Williams, Esq., F.R.S., "On the Female Poisoners of the Sixteenth and Seventeenth Centuries." Feb 26th. John H. Bridges, M.A., B.M., late Fellow of Oriel College, Oxford, "On the Influence of Civilisation upon Public Health." March 5th. William Huggins, Esq., F.R.S., "On the Latest Discoveries in Astronomy made with the Spectrum." March 12th. Professor Abel, F.R.S., "On some Applications of Electricity to Naval and Military Purposes." March 19th. Dr. Crum Brown, "On Chemical Constitution and its Relation to Physical and Physiological Properties."

A Newly-Discovered Property of Gun-Cotton.—It has been found that the explosive force of gun-cotton may, like that of nitro-glycerine, be developed by the exposure of the substance to the sudden concussion produced by a detonation; and that if exploded by that agency, the suddenness and consequent violence of its action greatly exceed that of its explosion by means of a highly heated body or flame. This is a most important discovery, and one which invests gun-cotton with totally new and valuable characteristics; for it follows, as recent experiments have fully demonstrated, that gun-cotton, even when freely exposed to air, may be made to explode with destructive violence, apparently not inferior to that of nitro-glycerine, simply by employing for its explosion a fuse to which is attached a small detonating charge. Some remarkable results have been already obtained with this new mode of exploding gun-cotton. Large blocks of granite and other very hard rock, and iron plates of some thickness, have been shattered by exploding small charges of gun-cotton, which simply rested upon their upper surfaces—an effect which will be sufficiently surprising to those who have hitherto believed, as every one has believed, that unconfined gun-cotton was scarcely to be considered as explosive at all, that it puffed harmlessly away into the air, not exerting sufficient force upon the body on which it might be resting to depress a nicely balanced pair of scales, supposing the charge to be fired upon one plate of the scale. Further, long charges or trains of gun-cotton, simply placed upon the ground against stockades of great strength, and wholly unconfined, have been exploded by means of detonating fuzes placed in the centre or at one end of the train, and produced uniformly destructive effects throughout their entire length, the results corresponding to those produced by eight or ten times the amount of gunpowder when applied under the most favourable conditions. Mining and quarrying operations with gun-cotton applied in the new manner have furnished results quite equal to those obtained with nitro-glycerine, and have proved conclusively that if gun-cotton is exploded by detonation it is unnecessary to confine the charge in the blast-hole by the process of hard-tamping, as the explosion of the entire charge takes place too suddenly for its effects to be appreciably diminished by the line of escape presented by the blast-hole. Thus the most dangerous of all operations connected with mining may be dispensed with when gun-cotton fired by the new system is employed. It will readily be observed that this discovery, which we believe is due to Mr. Brown, of the War Office Chemical Establishment, is likely to be attended with the most important results. Not merely is the strength of gun-cotton exploded in this way much greater than that of the same substance fired by simple ignition, but it now operates under conditions which were sufficient under the old system practically to deprive gun-cotton of its power. It has been said, and said justly, that if you want gun-cotton to exert itself you must coax it into the belief that it has a great deal to do. You must give it bonds to break and physical obstacles to overcome, with no outlet or possibility of escape. But now gun-cotton will exert itself, and put forth more than what was believed to be its full strength, whether it see any work to do or not. It will behave as less coy explosives have behaved before it—always with this difference, that it is half-a-dozen times as powerful as any of its rivals, with the exception of nitro-glycerine, to which in mere power even it is not inferior. This discovery, therefore, can hardly fail to give a considerable impetus to gun-cotton, and to lead to its universal adoption for mining purposes, as soon as its new properties become generally known. In connection with possible military applications the discovery is invaluable. There can no longer be any doubt what agent should be employed for the breaching of stockades and the like; and the absence of all necessity for the use of strong confining envelopes will have an important bearing on the employment of gun-cotton for torpedos and all submarine explosive operations, besides greatly simplifying mining and breaching operations in the field. We have, in fact, discovered several new advantages to add to those which already had sufficed to recommend gun-cotton as an explosive agent in preference to all others. The conditions that are fulfilled by a detonating fuse in determining the violent explosion of gun-cotton, under circumstances which hitherto have been altogether unfavourable to such a result, have been made the subject of investigation by Mr. Abel, and we hope at some future time to notice the conclusions at which he has arrived, as they appear to have a very important general bearing upon the conditions which regulate the development of explosive force, not merely from gun-cotton and nitro-glycerine, but from explosive compounds and mixtures generally. Meanwhile, it is satisfactory to be able to record what has been done, and to add that the subject is now occupying much attention at Woolwich and Chatham, under the intelligent direction of the department to which the discovery is due. —*Pall-Mall Gazette.*

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2362. E. S. T. Steane, Barking, Essex, "Improvements in the manufacture of soap."—Petition recorded July 28, 1868.

3098. H. Deacon, Appleton, Lancashire. "Improvements in the manufacture of sulphuric acid."—October 9, 1868.

3313. J. Heaton, Langley Mills, Derbyshire, "Improvements in the production of iron and steel."

3315. R. Oxland, Compton Gifford, Plymouth, Devonshire, "Improvements in the treatment of ores and minerals for the extraction of tin."—October 29, 1868.

3323. R. Irvine, Leith, N.B., "Improvements in the production of alcoholic liquors."—October 30, 1868.

3341. S. Schuman, Glasgow, N.B., "Improvements in treating and utilising fœcal matters, and in the apparatus employed therefor."—November 3, 1868.

3356. T. Robinson, Widnes, Lancashire, "Improvements in the manufacture of iron and steel."—November 5, 1868.

3376. H. Baker, Wigan, Lancashire, "Certain improvements in furnaces and fire-bars."—November 6, 1868.

3405. T. Rose, Oxton, Cheshire, and R. E. Gibson, New Brighton, Cheshire, "Improvements in utilising a certain waste material obtained in treating cotton seed, and in machinery employed therein."

3408. G. Clark, Northumberland Street, Strand, "Improvements in the treatment, manufacture, and use of explosive compounds."

3419. H. Bessemer, Cannon Street, London, "Improvements in the manufacture of cast-steel and homogeneous malleable iron, and in the fusion or melting of different kinds or qualities of iron and steel and their alloys, and also in the construction and mode of working the furnaces and apparatus employed for that purpose."—November 10, 1868.

3431. C. J. Chaplin, Bucklersbury, London, "An improved composition for cattle food."—A communication from E. Chaplin and E. Payne, Montreal, Canada.—November 12, 1868.

3459. J. B. Green, Bury, Lancashire, "Improvements in size used in preparing yarn or warps to be woven."

3471. H. Aitken, Falkirk, N.B., "Improvements in treating iron ores or iron stones."—November 14, 1868.

3484. A. McNiel, Tiverton, Devonshire, and W. Wheaton, Exeter, Devonshire, "An improved process for the manufacture of salts of ammonia from ammoniacal gas liquor."—November 16, 1868.

INVENTION PROTECTED BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

3511. H. D. Hoskold, Cinderford, Gloucestershire, G. P. Wheeler, Abinghall, Gloucestershire, "Improvements in the manufacture of artificial fuel."—Petition recorded November 19, 1868.

NOTICES TO PROCEED.

2810. H. B. Woodcock, Low Moor, Yorkshire, "A new manufacture of metal for axles, rails, tyres, and other purposes."

2811. C. Turner, Preston, Lancashire, "Certain improvements in furnaces."—September 12, 1868.

3050. J. G. Willans, St. Stephen's Crescent, Middlesex, "Improvements in the manufacture of iron and steel."—October 6, 1868.

3086. J. Dewar, M.D., Kirkcaldy, Fifeshire, N.B., "Improvements in preparing food from the entrails of animals."

3087. J. Dewar, M.D., Kirkcaldy, Fifeshire, N.B., "Improvements in making and preserving manure, and in deodorising offensive substances."—October 8, 1868.

2115. D. Hall, Winsford, Cheshire, "Improvements in the construction of furnaces, and in apparatus for supplying them with fuel."—Petition recorded July 2, 1868.

2137. E. H. Newby, King William Street, London, "Improvements in reducing aluminium from its ores or earths, and in producing alloys therefrom."—A communication from A. L. Fleury, Boston, Mass., U.S.A.—July 4, 1868.

2175. T. J. Mayall, Budge Row, London, "Improvements in the treatment of india rubber, gutta percha, or compounds thereof, and in the manufacture of type and other articles therefrom, for printing and other uses."

2177. J. Harris, Harefield Iron Works, Middlesex, and V. Pendred, Milton Road, Dulwich, Surrey, "Improvements in the manufacture of wrought-iron and steel."—July 9, 1868.

2207. A. Munro, Arbroath, Forfarshire, N.B., and W. B. Adamson, Glasgow, N.B., "Improvements in the manufacture of iron and other metallic substances."—July 13, 1868.

2265. J. Thomas, Newcastle-upon-Tyne, "Improvements in furnaces for smelting and melting."—July 18, 1868.

2278. L. Rose, Leith, "An improved aërated liquid or artificial champagne."—July 20, 1868.

2334. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of cast- and wrought-iron and steel, and in the furnaces employed therefor."—A communication from A. Ponsard, and F. E. Boyenval, Paris, France.—July 24, 1868.

2351. J. Higgin, Manchester, "Improvements in making aniline black, and in applying it to textile fabrics and yarns."—July 27, 1868.

2492. F. Le Roy, Commercial Road, Middlesex, "An improved non-conducting composition for preventing the radiation or transmission of heat or cold, and an improved method of applying the same."—August 10, 1868.

2542. W. Shaen, Bedford Row, Holborn, Middlesex, "Improvements in the manufacture of explosive compounds."—A communication from J. F. E. Schultze, Potsdam, Prussia.—August 14, 1868.

3036. R. Heilmann and P. Hart, Manchester, "An improved method of utilising the fumes or vapours evolved during certain chemical operations."—October 5, 1868.

3313. J. Heaton, Langley Mills, Derbyshire, "Improvements in the production of iron and steel."—October 29, 1868.

NOTES AND QUERIES.

Determination of Acetic Acid in Commercial Acetate of Lime.—"V.C." has called my attention to Fresenius's method with phosphoric acid. I should like to ask him whether he has tried it with the impure commercial acetate, brown or grey, and, if so, what effect the phosphoric acid has on the tarry compounds? I fear it would produce acid substances, which would vitiate the results.—G. N.

Drying Oils.—Your correspondent, "Waterproof," seems to be under the impression that the so-called drying oils become only really drying oils after having been submitted to heat, or to some such treatment as he speaks of, both of which, however, if well executed and continued for a sufficiently long time, will have the desired effect. The oils of linseed, poppy seed, walnuts, hemp seed, and a few others, are drying oils—that is to say, become very easily oxidised, and during this process of oxidation give rise to the formation of a caoutchouc-like substance; that substance is the protecting coating which is produced by the application of oil paints, and is akin to caoutchouc, and also impervious to water. Your correspondent does not wish to have heat applied to the oil he desires to use, and wishes it to be dry in twenty-four hours; good genuine, and especially old linseed oil, will be so itself without heating, provided the material or fabric to which it is applied be placed in locality where a dry and warm current of air is kept up, and provided the layer of oil be not too thick. If "Waterproof" would be kind enough to precisely state what for, and how he wants to use the oil, I could readily give him every aid, which I will do with great pleasure; let him recollect, however, that all the drying oils are in reality so, even immediately after having been obtained from the seeds; but for reasons which it would be too lengthy to enter into now, the older the linseed (raw) oil the better.—Dr. Adriani.

MEETINGS FOR THE WEEK.

Monday.—Medical, 8.
— London Institution, 6. Mr. Rodwell on "Heat Treated as a Science of Kinetics."
— Royal Institution 2. General Monthly Meeting.
Tuesday.—Photographic, 8.
Wednesday.—Society of Arts, 8. "On the Theory of Boiling, in connection with some Processes in the Useful Arts," by Charles Tomlinson, F.R.S., &c.
— Geological, 8. "Notes of a Geological Reconnaissance in Arabia Petrea," by H. Bauerman, Esq., F.G.S. "On the Occurrence of Sulphate of Strontia (Celestine) in the Tertiary Rocks of Egypt," by H. Bauerman, Esq., F.G.S. "On the Basalt Dykes of the Mainland of India, &c." by G. T. Clark, Esq., F.G.S. "On the Existence during the Quaternary Period of a Glacier of the Second Order, occupying the 'cirque' of the valley of Palhères in the western part of the granitic 'massif' of the Lozère," by Dr. C. Martins, For. Corr. G.S.
— Microscopical, 8.
Thursday.—Royal, 8½.
— Royal Society Club, 6.
Friday.—Astronomical, 8.

TO CORRESPONDENTS.

Yellow Oxide of Antimony.—We hear that about 30 tons of this article, which is seldom met with in quantity in the London market, has been shipped from Australia, and is expected to arrive about the end of the month.

W. H. Walenn.—The subject is under consideration, and our correspondent will probably hear further from us respecting it.

Communications have been received from J. Thompson; G. W. Eccles (with enclosure); London and General Water Purifying Company; R. R. Tatlock; Bollmann Condy, and Co. (with enclosure); P. Squire; H. Rastrick; J. O. N. Rutter (with enclosure); Dr. Otto Richter; J. Mayer (with enclosure); Mottershead and Co; C. K. Jewett, Göttingen; W. Hobbs; Dr. Angus Smith, F.R.S.; F. B. Baker; J. Bowing; Dr. R. C. Moffat; W. Sykes; S. S. Smith (with enclosure); R. Broadhurst; and F. W. Griffin.

THE CHEMICAL NEWS.

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ON THE
COMPOSITION AND METALLURGY
OF SOME
NORWEGIAN TITANIFEROUS IRON ORES.

By DAVID FORBES, F.R.S., &c.

Considerable attention has of late been directed to the utilisation of the titaniferous iron ores, which are found abundantly in New Zealand, Canada, Scandinavia, and other countries, under the supposition, entertained by many engaged in the manufacture of iron, that these ores yield, on smelting, an iron or steel alloyed with titanium and of very superior quality.

In the numerous articles and discussions which have appeared in English journals upon this topic the subject has been treated as one of entire novelty, and various patents have also been taken out, evidently under the impression that such ores had never previously been utilised, and that their treatment, as well as the nature of their products, had been previously quite unknown to metallurgists.

So far, however, from this being in reality the case, it is well known that the titaniferous magnetites of Sweden, Finland, and Norway, have, from very old periods, been mined and smelted on the large scale in the charcoal blast furnaces of those countries, where their metallurgic treatment and value are thoroughly understood and appreciated; and several Scandinavian iron-masters have expressed to me their surprise at the want of information possessed by English metallurgists in general upon this subject.

My own experience in the smelting of titaniferous iron ores dates from as far back as 1847, when I acted as consulent to some small charcoal iron works in the south of Norway, where such ores were smelted in quantity. From my notes and analyses I have extracted the following remarks, which may be regarded as a continuation of a short paper "On the Composition and Metallurgy of some Norwegian Iron Ores," which appeared in No. 416 of this journal (Nov. 22, 1867), and which may not be without interest to metallurgists.

Titaniferous Magnetite (Cristine Mine, Krageroe).—This ore occurs as a lode, or more properly, metalliferous zone, imbedded in the metamorphic schists in the small islands, or rather rocks, called Dybsunds Holmene, in the Krageroe fjord, in Southern Norway. The ore in this zone is about 6 feet wide, but generally occurs in lenticular masses, having a general strike of N.N.W., with a dip of 80° westerly. The metallic deposit is cut across by a posterior granite dyke, which, however, does not materially disturb its course. The ore itself is titaniferous magnetite; it is attracted by the magnet, but not very strongly so, and is intermixed with particles of colourless quartz and green-black hornblende, whilst it is occasionally seen to contain minute spangles of magnetic pyrites. Its colour is brilliant black, and it retains this colour and lustre even after long exposure to the air and moisture.

The analysis of this ore was conducted as follows:—A weighed amount of the ore was fused in a gold crucible with eight times its weight of bisulphate of soda, until all soluble matter had been taken up. The fused mass was treated with cold water until nothing remained but some pure white silica, which was filtered off, washed, and determined; to the solution, much diluted with water, a few drops of nitric acid was added (in order to prevent the titanic acid carrying down sesquioxide of iron along with it), and the whole boiled for a considerable period. The titanic acid thus precipitated was determined after ignition, when it possessed a light yellow colour. The alumina, oxide of iron, lime, and magnesia in the filtrate were now separated as usual, and the determination of the iron checked by the volumetric process (by bichromate of potash) upon a separate portion of the ore dissolved in nitro-hydrochloric acid, and also used for determining the amount of sulphur present. Phosphorus was sought for, but not discovered, although both Abel's and Spiller's methods (Chemical News, vol. vi., p. 133, and vol. xiii., p. 170), as well as the molybdate process, were employed. The following percentage results were obtained:—

Iron	42·04
Oxygen (as loss)	16·03
Protoxide of manganese	0·14
Alumina	2·61
Lime	2·11
Magnesia	1·88
Silica	19·90
Titanic acid	15·10
Sulphur	0·19
Phosphorus	0·00
	100·00

The experience of the Scandinavian iron-masters has shown that the only objection to the use of titaniferous ores is, that they are found to be more and more refractory in the blast furnace in proportion as they contain a greater percentage of titanic acid; and if much titanium is present, they require so much larger an amount of charcoal to smelt them as not to render their employment profitable in a country where other ores free from titanium can be obtained at a reasonable rate.

After considerable experience in smelting the above ore, which yielded a very good iron, it was found unprofitable to smelt it alone for the above reason; but its use was found beneficial when employed in about equal proportions with the other ores of the district which were free from titanium. In the attempts to cause it to smelt more easily, my predecessor, under the supposition that a volatile compound of silicon and titanium would be formed, fluxed this ore with gradually increasing charges of stamped quartz, until at last a cast-iron was obtained so highly charged with silicon that it flowed from the furnace like porridge.

I, on the contrary, used lime as a flux, and probably went at first to the other extreme, with the object of slagging off the titanic acid as titanate of lime, but I did not obtain a satisfactory result; subsequently, however, the examination of some silico-titanates, which proved much more fusible than pure titanates, led me to employ a mixture of stamped quartz and limestone as a flux. This was found to give very satisfactory results in practice, and when the amount of titanium in the ore did not exceed 8 per cent, or was reduced to this percentage by admixture of other ores of iron free from titanic acid, no difficulty was experienced in working this ore cleanly and profitably. The cast-iron produced, upon analysis, did not contain phosphorus, only a trace of sulphur, and afforded 0·05 per cent titanic acid, equal to 0·03 per cent titanium, which I imagine was rather mechanically intermixed than chemically combined with the iron.

The cast-iron, however, possessed a peculiar fracture, not easily described, but easily distinguished by the furnace men, who could at once recognise the pig from these ores, even after it had been re-melted in the cupola.

The slags from this ore (and titaniferous ores in general), even in cases where it had only been employed as an admixture of as low as 10 per cent of the charge, are at once recognisable, both by their behaviour when fluid, as well as their appearance and fracture when cold. As they flow from the furnace, a series of blisters (if they may be so called) rise up from the slag, sometimes to the height of from 6 inches to a foot, and about the thickness of the wrist; after standing up thus for some minutes with a very peculiar appearance, they suddenly collapse, and sink into the still fluid current of slag, leaving merely a depressed mark to show where they had previously raised themselves.

When cold the slag has generally an external glassy coating, about ¼th to ¾ths of an inch in thickness, of a greenish or greenish brown colour, beneath which the whole mass is an agglomeration of crystalline needles, of a brown or brownish yellow colour, often very porous.

Many of these slags are tinged blue, especially when more compact, and they have often a fine blue colour at the points of junction of the crystalline internal mass with the external vitreous coating, this colour being probably due to the reduction of the titanic acid to a lower state of oxidation.

The blast furnace in which these ores were smelted possessed the following dimensions:—Total vertical height from sole of hearth to charging plane, 32 feet; height from hearth to tuyeres, 1½ feet; ditto to shoulder, 6 feet; ditto from shoulder to widest diameter, 2 feet; diameter at hearth, 2 feet; ditto at shoulder, 4 feet; ditto at widest part, 7 feet; ditto at charging plane, 5 feet. The blast was provided by three square boxes, and was heated to about 500° F. (260° C.) by the waste gases from the furnace. The ore was roasted in furnaces situated on the top of the furnace and heated by the waste gases, and after roasting it was broken up to the size of nutmegs by rollers. The charcoal employed was a mixture of spruce fir, and pine, and it required 40 English cubic feet of this charcoal (about 3744 lbs. in weight) to produce 1 ton cast-iron. The total yield of cast-iron per week from these small furnaces was, on an average, about 16 tons, the ore producing about 33 per cent iron.

Titaniferous Magnetite (*Gullaxrud Mine, Eger*).—The occurrence of this ore is very strikingly similar to that of the last described, and it may be stated that the majority of the titaniferous iron deposits of Scandinavia which I have examined possess characters of great similarity with one another, seldom or ever being found as true metallic lodes, but usually as deposits in the metamorphic schists (generally hornblendic) in lenticular masses, which arrange themselves in the direction of the foliation of the rock itself.

In the Gullaxrud mine the long axis of the lenticular mass of iron ore runs about east and west, the deposit dipping at a high angle (80°) to the north; and at the point upon which the main workings have been sunk the clean ore possessed a width of about 18 feet.

The mineral is a titaniferous magnetite of a brilliant deep black colour, which does not change or rust upon exposure to air and moisture; it contains a somewhat intimate admixture of hornblende and quartz with specks of magnetic sulphide of iron, and the whole is slightly attracted by the magnet.

The analysis was conducted in the same manner as in the case of the previously-described titaniferous magnetite from Krageroe, with the exception only that the phosphorus present was separated by fusion with carbonate of soda, and afterwards determined as pyrophosphate of magnesia in the usual manner. The results obtained were as follows:—

Iron	38·89
Oxygen (as loss)	14·84
Protoxide of manganese	0·48
Alumina	1·70
Lime	3·55
Magnesia	3·98
Silica	28·10
Titanic acid	7·10
Sulphur	0·59
Phosphorus	0·77
	100·00

The amounts of phosphorus and sulphur contained in this ore are so large as to prevent its being employed for the production of charcoal bar-iron, as the trial smeltings made for this purpose showed that the bars obtained were extremely red-short. The abundance of the ore, and its consequent cheapness, as well as its proximity to the smelting works, rendered it, however, of importance for the production of casting pig. A sample of this pig was examined by me, and found to contain both sulphur and phosphorus, along with 0·26 per cent titanic acid, equivalent to 0·16 per cent metallic titanium, which most probably was only mechanically intermixed, and not alloyed or chemically combined with the iron.

The ore when smelted alone was found to be refractory, and not to produce a liquid slag; but this difficulty disappeared when it was smelted along with other ores free from titanium, in a similar manner to the titaniferous magnetite from Krageroe before described.

THE ZIRCONIA LIGHT.

Messrs. Tessié du Motay and Co. have patented an invention for improvements in preparing zirconia, and the employment of the same to develope the light of oxyhydrogen flame. The specification is as follows:—

Zirconia, or oxide of zirconium, in whatever manner it may be extracted from its ores, can be agglomerated by compression; for example, into sticks, discs, cylinders, or other forms suitable for being exposed to the flame of mixtures of oxygen and hydrogen, without undergoing fusion or other alteration. Of all the known terrous oxides it is the only one which remains entirely unaltered when submitted to the action of a blowpipe fed by oxygen and hydrogen, or mixtures of oxygen with gaseous or liquid carbonated hydrogens. Zirconia is also, of all the terrous oxides, that which, when introduced into an oxyhydrogen flame, developes the most intense and the most fixed light.

To obtain zirconia in a commercial state I extract it from its native ores by transforming by the action of chlorine in the presence of coal or charcoal the silicate of zirconium into double chloride of zirconium and of silicium. The chloride of silicium, which is more volatile than the chloride of zirconium, is separated from the latter by the action of heat; the chloride of zirconium remaining is afterwards converted to the state of oxide by any of the methods now used in chemistry. The zirconia thus obtained is first calcined, then moistened, and submitted in moulds to the action of a press with or without the intervention of agglutinant substances, such as borax, boracic acid, or clay. The sticks, cylinders, discs, or other forms thus agglomerated, are brought to a high temperature, and thus receive a kind of tempering or preparing, the effect of which is to increase their density and molecular compactness.

I can also compress in moulds shaped for the purpose a small quantity of zirconium capable of forming a cylinder or piece of little thickness, which may be united by compression in the same mould to other refractory earths, such as magnesia and clay. In this manner I obtain sticks or pieces of which only the part exposed to the action of the flame is of pure zirconia, while the remaining portion which serves as a support to it is composed of a cheap material.

The property composed by zirconia of being at once the most infusible, the most unalterable, and the most luminous of all the chemical substances at present known when it is exposed to the action of an oxyhydrogen flame, has never before been discovered, nor has its property of being capable of agglomeration and moulding, either separately or mixed with a small portion of an agglutinant substance.

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Continued from page 256.)

Preservation of Food—Unwholesome and Adulterated Food.

It requires no argument to show that the preservation of food is a matter of great public importance; for it not only enables us to provide against actual want in periods of unusual scarcity, but it also affords the means of equalising the distribution of food at all times, so that the excess of one country may be used in supplying the deficiency of another. In the pastoral districts—for example, of Canada, Australia, Tasmania, the Cape of Good Hope, Mexico, the Argentine Republic, and the Brazils—thousands of tons of meat are always available as food, and yet they are lost to us because of the difficulties of preserving it. In South America, at least 2,000,000 beasts are annually slaughtered for the fat, skin, and bones, the flesh of which could be supplied here at less than 2½d. per lb. So also in Australia, the amount of meat available as food is practically inexhaustible. Last year Mr. Philpott stated to the Food Committee of the Society of Arts, that he himself was in the habit of melting down from 1,000 to 1,500 sheep daily for four months together; and that in the vast districts of rich pasture-land from Victoria to Brisbane, there was an unlimited supply of the very finest meat—all of which was at present entirely wasted, because of the difficulty of disposing of the flesh; and therefore the carcases of the animals were melted down for fat. A bullock in Australia, he said, costs only from £3 to £4; and legs of mutton of the very best quality were, when salted, sold for 3s. a dozen. If some simple and practicable means could be devised for preserving such meat, it might be supplied to our markets at less than 3d. a pound.

Until recently, the only process employed for this purpose was the rude method of salting the meat, but the deterioration of it was so obvious, and the distaste for it so general, that it was only practised to a limited extent, and for occasions when fresh meat could not be obtained. The salt junk of the navy in olden time was a good example of the wretchedly unwholesome and indigestible meat prepared, for it could hardly be called preserved, by this process. Recognising, therefore, the necessity for a better means of preserving food, the naval authorities of every country appealed to science, and gave the largest encouragement to inventors. A further stimulus to invention was created by the necessity for supplying our Arctic explorers with good and wholesome food during their long winter residence in the frozen seas of the North; and as that inquiry was set on foot, not merely for the purpose of discovering a north-west passage to our possessions in America, but also with the view of prosecuting scientific research in almost inaccessible regions, an unusual inducement was offered for the preparation of such food. The demand thus created was soon acknowledged by science, and was also met by the practical skill of the manufacturer, so that the Arctic voyager went confidently on his journey, knowing that he had other food than the unwholesome junk of the navy. The earliest preparations supplied to him were mixtures of dried meat with sugar and spice (pemmican), but after a time they were furnished with fresh meat preserved in air-tight cases. At first the supply was chiefly for voyagers in cold countries, but when the value of this method of preservation became known, the European residents of hot climates, as India, eagerly sought for the fresh foods which they were accustomed to use in their own country, and thus an additional stimulus was given to this process of manufacture. At the present time it has acquired gigantic proportions.

I have before me a list of the specifications of patents relating to the preservation of food, from the year 1691 to the end of 1855, and I find that only one was described in the seventeenth century, and three in the eighteenth, while as many as 117 were specified in the first fifty-five years of the present century. Invention, however, has not been prolific of new processes, for it is mainly confined to an application of one or two simple elementary principles—26 of the patents, for example, are for the preservation of food by drying; 31 by excluding atmospheric air; 8 by covering the food with an impervious substance, as fat, extract of meat, gelatine, collodion, &c.; and 7 by injecting meat with various salts.

But before we proceed with the examination of these processes, it will be advantageous to inquire a little into the circumstances which favour organic decomposition. It would seem, from experiment and observation, that three concurrent conditions are absolutely necessary for active putrefaction—viz., the presence of much moisture, the access of atmospheric air, and a certain temperature, as from about 40° to 200° of Fahrenheit; any of these being absent, the organic substance resists decay. All preservative processes must, therefore, depend on an application of one or other of these principles; and perhaps we may add a fourth—viz., the action of chemical agents. Let us review them in detail.

1st. The preservation of substances by drying them is of very ancient date. In our anatomical museums we have long known that specimens of the animal body may be preserved for an indefinite time by drying them, and then varnishing them so as to exclude the moisture. Here is a dissection prepared in that manner, which has been used for lecture illustration at the London Hospital for more than half a century, and yet it is as sound as when it was made. In warm climates it has been a practice for ages to preserve fish, and even meat, by drying them—the meat being cut into strips and exposed to the action of warm dry air. Charqui, or South American beef, which you see here, is an example of it. It is obtained from animals that are grass-fed, and they are killed by pithing and then bleeding them. Directly the hide is taken off, the flesh is stripped from the bones and allowed to cool. It is then placed on a table, and jerked, or cut up into thin slices, which are piled up in heaps with alternate layers of salt. After standing twelve hours the meat is turned, and fresh salt is added where necessary. The next day the salted strips are placed upon hurdles, and exposed to the sun to dry. It requires two or three days to dry the meat thoroughly, and, for fear of damp, it is always taken indoors at night. There are several varieties of this meat—as pato, which is the best and most free from sinew; manta, the second quantity; and tasajo, the third, which is very thin and full of sinews. All the varieties require to be well soaked in water, and then to be cut small and cooked by prolonged boiling. But animal foods are not well preserved in this manner, as they lose their flavour, and become tough and indigestible; the fat also gets rancid, and in damp weather the meat absorbs moisture and becomes mouldy and sour. Perhaps the lean parts of meat—as the heart, tongue, and strips of muscle—might be advantageously preserved in this way, especially in warm and dry climates. The Food Committee of this Society reported favourably of a specimen of dry powdered beef from Queenstown, which they said was in excellent condition, and contained about four times as much nutritious matter as ordinary meat. Generally, however, the fat is very rancid, even when pains are taken to prevent the substance from getting mouldy. It is for the same reason that all attempts to preserve milk and the yolk of eggs by drying have failed, although the dried white of egg will keep well, as in the process of Mr. Charles Lamont, where the albumen is dried in thin scales—forty-four eggs making about 1 lb. of the preparation. Absorbent substances mixed with the fatty food will obviate the difficulty, to some extent, as in the preparation of pemmican, where sugar and spice are added to the dry powdered meat; and in the several processes for preserving milk by evaporating it and mixing it with sugar, &c., as in the patents of Newton (1835), Grimwade (1847 and 1855), Louis (1848), &c.; as well as the process of Davison and Symington (1847), for preserving eggs by mixing the yolks and whites with flour, ground rice, or other farinaceous substance, and drying. Extract of meat also may be preserved in the same manner, as in the patent of Donaldson (1793), of Robertson (1851), and of Borden (1851), where the extract, after the separation of fat, is mixed with farinaceous matters; in the last case it is also baked in the form of biscuits. In the year 1854, MM. Blumenthal and Chollet obtained their patent for combining meat and vegetables in the form of tablets, by first drying the vegetables and pressing into cakes, and then submitting them to successive immersions in rich soup—allowing them to dry in warm air after each immersion. When the extract of meat is made without fat or gelatine, as in the case of Liebig's extract, it may be kept for a long time in a pasty condition, without mixing it with farinaceous matters, although the preparation of it with baked flour, as already described, is a great improvement.

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* The Cantor Lectures, delivered before the Society of Arts.

The process of drying is, however, best adapted for the preservation of vegetable substances, and it has been so used from time immemorial, as in the keeping of pot-herbs, in preparing the tea-leaf, in making hay, &c. In this country, the first recorded patent for preserving vegetables by drying them was granted in 1780, to John Graefer, who sought to retain the flavours of vegetables by first dipping them in boiling salt and water, and then drying. Forty years later (1820) John Vallance obtained a patent for preserving hops by drying them, and then compressing them into a small space. Then came the patents of Edwards (August, 1840), for boiling, granulating, and drying potatoes; and of Grillett (November, 1840), for preserving both cooked and uncooked potatoes by drying. Ten years afterwards (in November, 1850) Masson obtained his patent for preserving vegetables by drying them and forcibly compressing them, so that they were reduced to one-seventh their original bulk—a cubic yard containing rations for 16,000 men. This process has been very successful, and it is still practised by Devaux, Chollet, and others, for it serves for the preservation of all kinds of vegetables—as potatoes, cabbages, carrots, cauliflowers, beans, apples, &c.; and when steeped in water they re-absorb their natural proportions of moisture and swell out to their original size. They are, however, somewhat deficient of flavour, and they require prolonged boiling, as from one and a half to one and three-quarter hours, to cook them.

By a more careful process of drying, Mr. Makepeace has managed to preserve both the colour and the flavour of vegetables, especially of pot-herbs, as you may see from these specimens.

Altogether there are, or have been, about thirty-one patents in this country for the preservation of various articles of food by drying them.

2nd. The preservation of organic matter by excluding atmospheric air is, like the last, a very ancient process. The old practice of burying the dead in leaden coffins, and the still more ancient custom of swathing them in resinous bandages or waxed cloths (called cerements), owe their preservative powers to the exclusion of atmospheric air; and it is remarkable, seeing the efficacy of the process, that the scientific principle of it was not long ago recognised and applied to the preservation of food. The first patent of the kind that I am acquainted with in this country, was granted to Francis Plowden, in June, 1807; and he describes it as a process for "preserving butchers' meat, animal and other comestible substances, by encrusting them with a substance, which must not only resist the effects of atmospheric air, but must not communicate any noxious quality to its contents," and for this purpose he employed essence or extract of meat—the substance being dressed, so that it may preserve the longer, is wiped dry, and put into a wooden vessel, and the hot extract is poured over it in a fusible state, so as to find its way into every vacuum. Three years later (in February, 1810), Augustus de Heine took out the first patent for preserving meat, by exhausting the air from the vessel containing the meat, and he contrived a machine for the purpose, as the action of the common air-pump was tedious. Six and thirty years after this (1846) the late Mr. Warington, of Apothecaries' Hall, obtained his patent for the preservation of animal substances, by coating them with common glue, gelatine, or concentrated meat gravies, or otherwise by dipping them in warm solutions of such substances; or by wrapping them in waterproof cloth, or covering them with caoutchouc, gutta-percha, or varnish. These mark the starting-points of the various processes now in use; for example:—

(*a*). Of those which owe their operation to the exclusion of air, by filling up the vessel with something hot, there are the patents of Plowden (1807), who used rich gravy or extract of meat; of Granholm (1817), who used hot fat or hot animal jelly; and of Wothly (1855), who used oil, as in preserving anchovies. I am rather surprised, considering how easily the exclusion of air is effected by surrounding the substance with hot fat, that this method of preserving meat has not been adopted in Australia and South America; for as the fat which they prepare from their wild stock is sent to this country in casks, there would be no difficulty in sending with it the finer descriptions of joints, as legs of mutton and good pieces of beef. The process should be conducted as follows:—When the fat is melted, and is at a temperature of from 240° to 250° Fahr., the fresh joints should be plunged into it, and kept there for a few minutes, so that the superficial moisture might be thoroughly evaporated. They should then be immediately packed in sound dry casks, and filled up with hot fat, at a temperature of 212° or thereabout. In this manner the fat and the joints might be transmitted to this country, and on their arrival there would be no difficulty in melting the fat while in the casks, and then removing the preserved joints.

Vegetable substances are frequently preserved in bottles filled up with hot syrup, and the practice is a very old one. Hot water is also used for the same purpose, and this method dates from the year 1807, when this Society gave a premium to Mr. Saddington for his method of preserving fruits without sugar. His process was to gather the fruit a little before ripening, and to put it immediately into clean bottles,—filling the bottles with the fruit to the neck. They were then placed in a vessel of cold water, and heat was applied until it rose to the temperature of 160° to 170° Fahr. After standing exposed to this temperature for half an hour, the bottles were filled up to within an inch of the top with boiling water, and were then immediately corked and covered at the top with cement. The action of the heat was not merely to expel atmospheric air from the bottles, but also to coagulate the vegetable albumen of the fruit. Fruits and green vegetables are still preserved in this manner, a little alum being generally added to the water in the bottle for the purpose of hardening the tender skin of the fruit, and so preventing its disfigurement by bursting.

(*b*). A process not very unlike the preceding is that which consists in the destruction of the oxygen of the air in the vessel by heating the substance in it. This is the plan of M. Appett, who, in 1810 (three years after the publication of Mr. Saddington's method), obtained the reward of 12,000 francs, offered in the preceding year by the French Government, for the best method of preserving food. Here is the book which M. Appert wrote at the time, and he tells us to cook the food to some extent, and put it into strong glass bottles—filling them almost to the top. The bottles are then to be securely corked, and exposed for some time to the action of boiling water. To guard against accident from bursting, the corks are to be wired down, and the bottles wrapped up separately in cloths. After this the corks are to be well covered with pitch, to exclude atmospheric air. A like process was patented in the autumn of the same year (1810), by Mr. Peter Durand, who, no doubt, derived it from the published account of M. Appert, dated nine months before; and since then many such patents have been obtained, which I need not describe. Attempts have frequently been made to preserve milk by this process. Appert recommended that the milk should be boiled down to about half its bulk before putting it into the bottles; and in 1847 Bekaert tried to improve the process by adding carbonate of soda to the milk. Later still, in the same year, Martin de Lignac obtained a patent for preserving milk, by evaporating it to one-sixth of its bulk before bottling it. Then there were the patents of Symington and of Moreau (1853), but all these methods have failed in practice on account of the difficulty of preventing the separation of the butter.

(*c*). The preservation of food by exhausting the air from the vessel containing it dates, as I have said, from the year 1810, when Augustus de Heine proposed to use a vessel with a valve in the top of it, which allowed the air to be drawn out by means of a special apparatus, but not again to enter. The exhaustion, however, was so imperfect that the process did not answer. In 1828 Mr. Donald Currie improved it by admitting carbonic acid gas into the vessel after it was thoroughly exhausted; and later still, in 1836, M. Leignette still further improved it, by filling the vessels containing the food with salt and water, and then letting out the liquid through the aperture, which remained open for that purpose, while carbonic acid gas went in. Six years after this (in 1842), Mr. John Bevan patented a process for drawing out the air by an exhausting apparatus, and then admitting a warm solution of gelatine, and in 1846 Mr. Rettie employed, in like manner, a solution of common salt. But none of these methods were successful; nor was the patent of Mr. Ryan, in 1846, for using gases, chiefly acetic acid vapour and carbonic acid gas. The most perfect process of this kind was patented by Messrs. Jones and Trevethick. It consists of an apparatus whereby the exhaustion of the vessel containing the raw food is effected in an air-tight trough of water, and thus the entrance of air and the collapse of the sides of the vessel are completely prevented. After the exhaustion pure nitrogen is admitted into the vessel, for the purpose of diluting the residuum of air, and it is again exhausted. Lastly, a charge of nitrogen, containing a little sulphurous acid, is let into it, and thus the last trace of oxygen is chemically absorbed. The vessels are now in a proper condition for removal from the air-tight water trough and for having the apertures sealed with solder. Meat, fish, and poultry preserved in this manner has been found good after seven or eight years; and specimens of them were exhibited in the London Exhibition of 1862.

(*d*). The most common method of driving out the air is by means of steam. The food is put, with a charge of water, into a tin case with a hole in the top, and when the water is boiling actively, and steam has displaced the air, and is escaping freely, the hole is stopped with solder. This process dates as far back as 1820; but the first patent for it was granted to M. Pierre Antonie Angilbert, in 1823. He had, however, a very rude method of applying heat to the tin vessels, and this was improved by Wertheimer in 1840. In the month of January of the year following, Mr. Gunter improved it still further; and later in the same year both Goldner and Wertheimer obtained patents for using a bath of muriate of lime for heating the vessels. This, in fact, is the practice at the present time by Goldner, McCall, Richie, Morton, and others, who are largely engaged in the preservation of food. The details of the process for effecting it are as follows:—The raw meat and vegetables are put into the canisters and soldered down—a pin-hole aperture being left in the lid. The canister is then subjected to the heat of the bath (a little above 212°) until the contents are about two-thirds cooked; and then, while the steam is blowing freely out, the aperture is dexterously sealed tight with solder. The canister is then painted over with a stiff oil paint, and is exposed for some time in the testing room to a temperature sufficiently high to promote decomposition. If the canister shows no sign of bulging out from the generation of putrefactive gases, it is considered sound. Messrs. Hogarth and Co., of Aberdeen, use steam instead of the muriate of lime bath.

Meat preserved in this manner will keep for a considerable time. At the Exhibition of 1851 vouchers were given for some of the samples that had been preserved for twenty-five years; and at the Exhibition of 1862 I examined specimens of food that had been kept for more than thirty years. To-night, through the kindness of Messrs. Crosse and Blackwell, I am able to show you a specimen of preserved mutton which has been in the case forty-four years, and you will perceive that it is in excellent condition. It formed part of the stores supplied by Messrs. Donkin and Gamble in 1824 to his Majesty's exploring ship "Fury," which was wrecked in Prince Regent's Inlet in 1825, when the cases were landed with the other stores, and left upon the beach. Eight years afterwards (in August 1833), they were found by Sir John Ross in the same condition as they were left; and he wrote to Mr. Gamble at the end of that year saying "That the provisions were still in a perfect state of preservation, although annually exposed to a temperature of 92° below and 80° above zero." Some of the cases were left untouched by Sir John Ross; and after a further interval of sixteen years, the place was visited by a party from H.M.S. "Investigator," when, according to a letter from the captain, Sir James Ross, "the provisions were still in excellent condition, after having laid upon the beach, exposed to the action of the sun and all kinds of weather, for a period of nearly a quarter of a century." Messrs. Crosse and Blackwell have placed the original letters in my hands for perusal, and they show, beyond all doubt, that meat preserved in this manner will keep good for nearly half a century—in fact, the case of boiled mutton now before you has been preserved for forty-four years. There can be no question, therefore, as to the success of the process; and hence it is largely practised, not only in this country, but also in our colonies, where food is abundant. In this way preserved salmon and lobsters are sent to us from Newfoundland, turtle from Jamaica, beef and mutton from Canada, and the dainty tail of the kangaroo from Australia. There are, however, two serious objections to the process—namely, that the meat is nearly always overcooked, and the cases are likely to buckle and crack from the constant pressure of the atmosphere—there being a vacuum within them. The over-cooking arises from a desire to ensure the complete exclusion of atmospheric air by the steam. Mr. Nasmyth has proposed, in his patent of 1855, that a little alcohol should be mixed with the water, so that the boiling-point may be reduced; while Mr. McCall, taking advantage of the absorbent action of sulphite of soda on oxygen, recommends a less prolonged boiling and the use of a little of that salt. The salt is contained in a small capsule, fixed by means of soft solder to the inner surface of the cover of the case. When the food is about two-thirds cooked, and steam is freely escaping, the hole in the lid is stopped with a very hot iron, which melts the soft solder of the capsule within, and so sets free the little pellet of sulphite of soda, which speedily absorbs the remnant of oxygen left in the case.

The other difficulty, namely, the cracking of the case from atmospheric pressure, is obviated, as I have already explained, by the introduction of inert gases, as carbonic acid, nitrogen, &c., and with a little sulphurous acid, and these have been the subject of many patents, as of Currie (1828), Leignette (1836), Ryan (1846), Nasmyth (1855), and others.

(*e*). The last method of any importance for excluding atmospheric air from food is by coating it with some impervious material. This plan, as I have already stated, was first suggested by the late Mr. Robert Warington, who in March, 1846, obtained a patent for the use of "common glue, gelatine, or concentrated meat-gravies; or thin cream of plaster-of-Paris, which, when set hard, was to be saturated with melted suet, wax, stearine, &c." "The things were then to be wrapped in water-proof cloth, or covered with caoutchouc or gutta-percha; or coated with a varnish of these substances; or kept submerged in glycerine, treacle, elaines, oils, or other such matter not liable to oxidation." Nine years after this, in January, 1855, a patent was obtained by Messrs. Delabarre and Bonnet for preserving meat, bread, eggs, vegetables, or pastry, by coating them with a varnish made from the flesh and bones of animals, by boiling them, and obtaining a rich syrup. This, when clarified, was used to cover the parboiled meat or vegetables. In the month of February in the same year, a like patent was granted to Mr. Hartnall for a process of preserving animal and vegetable substances by immersing them in baths, consisting of gelatine and treacle dissolved together in certain proportions; then drying, re-dipping, and covering with charcoal powder. Later still, in the same year, Mr. Brooman patented the use of albumen and molasses as a coating for meat, after the meat had been partially dried, and then suspended in an air-tight vessel charged with sulphurous acid. Lastly, in the month of December of the same year, Messrs. Bouëtt and Douein obtained provisional protection for the use of collodion, either alone or mixed with other suitable substance.

But the best example of this method of preserving meat is the process of Dr. Redwood, whereby the meat is first covered with paraffin, and then with a flexible coating of gelatine, mixed with glycerine or treacle. The joints are dipped into a bath of paraffin having a temperature of from 240° to 250° of Fahrenheit, and are kept therein until the surface moisture is evaporated. They are then transferred to a colder bath of paraffin, from which they receive two or three coatings prior to their being covered with the last flexible covering of gelatine, &c. When the meat is required for use, the paraffin is easily removed from it by plunging it into boiling water, which dissolves the flexible coating and melts the paraffin. The paraffin floats upon the water, and, when cold, may be collected for future use.

The common methods of preserving foods by forcing them into skins, as in the case of German sausages, lard, &c., is of very ancient date, although a patent was granted to Mr. Palmer in 1846 for the preservation of the fat of beef, mutton, veal, or lamb, when fresh, by melting them, straining, and then packing in bladders.

3rd. The preservation of food by cold is a well-known process, for every one is acquainted with the fact that meat will keep for a long time in the winter season without deterioration; but the extent to which this preservative power may be carried is not well known. Animals, we are told, have been found in a perfect state of preservation in the frozen earth of the arctic regions, where they must have been buried for centuries. Last year, indeed, a communication was made to the Royal Society by Dr. Carl von Bear of the fact that the entire body of a mammoth was found in the frozen soil of Arctic Siberia. How long it has been so preserved it is hard to conjecture, but it must have been there for ages. Another good example of the preservative power of cold was observed in Switzerland in the autumn of 1861, when the mangled bodies of three Chamounix guides were found at the lower part of the Glacier de Boissons. The flesh of the bodies was perfectly preserved, notwithstanding that 41 years had elapsed since the unfortunate men lost their lives. They were carried away by an avalanche from the grand plateau of Mount Blanc, in the month of August, 1820, while attempting to ascend the mountain with Dr. Hamell; and no trace of them was discovered until the corresponding month of 1861, when, by the slow descent of the mountain ice, their remains were brought to the lower glacier. So well is this preservative power of cold known to the inhabitants of Russia, Canada, and other northern climates, that it is a common practice to slaughter fat animals on the approach of winter, when fodder is getting scarce, and to preserve their carcases by burying them in the ice or frozen earth; and they are thus preserved from the middle of November to the early part of May. We also have a practice of packing salmon in ice; and we receive game and poultry from America, and send the like to India in boxes surrounded with ice. The application of this method of preserving food is almost without limit, for not only can we obtain a stock of ice for such a purpose in the winter season, but it may be brought to us at any time from colder regions of northern Europe, or it may even be manufactured at a cost of less than half-a-guinea a ton. There is a machine of Mr. James Harrison, of Australia, made in this country, which is said to be capable of producing 8,000 lbs. of ice a day, at a cost, including all expenses, and with a good margin for profit, of ten shillings a ton. Why, therefore, may we not use ice in the summer months for the preservation of food? Dealers could easily provide themselves with close rooms containing ice, in which the food might be placed; and we ourselves might use ice-boxes more commonly in our households. It might interest you to know that the first patent for the preservation of food in this manner was granted to John Lings, in 1845.

Again, a temperature of from 200° to 212° will also arrest putrefaction; and joints of meat may be preserved for a time by dipping them every now and then in boiling water.

The fourth and last method of preserving food is by the use of chemical agents, called antiseptics, which act by destroying infusorial and fungoid life, and by forming compounds which are not prone to decay. Foremost of these is common salt, which has been used from the earliest time; but it is not a good agent for the preservation of meat, as it renders it tough, gives it a bad flavour, extracts the soluble constituents of it, and makes it hard and indigestible. The process, however, is much better managed at the present time than formerly, when the hard junk of the navy was the common diet of our sailors; and, considering how easily it is applied, it is not surprising that it is almost universally practised. In some parts of England and Wales it is the custom of the better classes of agricultural labourers to fatten a pig during the summer, and kill it and salt it for the winter. Hams and tongues are treated in like manner; and so are fish when they are plentiful among the inhabitants of our coasts. As far back as 1800 a patent was granted to Mr. Benjamin Batley for curing and preserving herrings and sprats by salting them; and it would seem that his process was very successful, for in the following year he obtained a patent for the like treatment of other fish. The dainty *caviare* of the Russian is nothing but the salted roe of the sturgeon. Even vegetables may be preserved in salt and water, as in the case of olives.

Other saline substances, saltpetre, acetate of ammonia, sulphite of potash or soda, muriate of ammonia, &c., are also good preservative agents, and are the subjects of several patents. Here is a specimen of meat preserved by wetting it with the solution of one part of acetate of ammonia and nine of water; and here another, which has been similarly treated with a weak solution of sulphite of soda. It is only necessary to brush the solution over the surface of the fresh meat, and when dry it will leave the meat in such a state as to resist decay. Instead of covering the meat with the solution, it may be injected with it, as in the patents of Long (1834), Horsley (1847), Murdoch (1851), and others.

After meat or fish is salted, it is frequently dried and smoked by exposing it in close chambers to the vapours of smouldering peat, wood, straw, &c., and in this manner it becomes impregnated with the dark-brown empyreumatic oil of the burning wood. The chief agent concerned in the preservation of food thus treated is the creosote of the empyreumatic oil, and this it is which gives the food a smoky flavour. A like effect may be produced by dissolving the creosote of wood-tar in vinegar, and brushing it over the salted joint. The creosote of coal-tar (carbolic acid) is also a powerful antiseptic, but its flavour is not agreeable, and therefore it is not used in the preservation of food, although it is extensively employed in the form of coal-tar, dead-oil, or creosote, in the preservation of wood, canvas, &c.; and the perfection of purity to which it is now brought by Dr. Crace Calvert and other manufacturers, encourages its use in medicine and surgery.

Spirit of wine and vinegar are other preservative agents which owe their antiseptic power to their destructive action on infusorial life, and to their combining with the albuminous constituents of food. Cherry brandy and pickles are good examples of this.

Lastly, I may state that the fumes of burning sulphur (sulphurous acid) are very powerfully antiseptic, and many patents have been taken out for their employment in the preservation of food. In the spring of 1854, Laury obtained a patent for it, the gas being introduced into the vessel containing the substance to be preserved. Later in the same year Bellford received provisional protection for the use of sulphurous acid with about one-hundredth of its volume of hydrochloric acid—the object being to prevent the sulphurous acid combining with the alkaline salts of the meat, and so giving it an unpleasant taste. The acids were to be used in solution, and the meat immersed in it for twenty-four hours. In the following year (1855) there were three patents—those of Brooman, Demait, and Hands—for the use of the acid in a gaseous form; and in the specification of Demait it was directed that the substance should be preserved by hanging it up in a chamber, and exposing it for a time to the action of the gas. Professor Gamgee has revived this process in a recent patent, and with certain modifications. He recommends, for example, that the animal should be made to inhale carbonic oxide gas, and when it is nearly insensible it should be bled in the usual way. After the carcase is dressed, it is to be suspended in an air-tight chamber, which is to be exhausted of air, and then filled with carbonic oxide gas, to which a little sulphurous acid has been added. It is to remain exposed to these gases for twenty-four or even forty-eight hours, and is then to be hung up in dry air; after which it is said that the carcass will keep for many months without perceptible change in taste or appearance. The process has been tested by killing meat in London and sending it to New York, and after the lapse of from four to five months, the meat has been pronounced good by a practical butcher. I am very much inclined to think that the real preservative agent is the sulphurous acid, and that the highly-poisonous carbonic oxide gas might be advantageously excluded from the chamber.

And now, in leaving this part of the subject, I cannot refrain from saying that the history of these patents for the preservation of food affords very striking instances of the necessity for an amendment of our patent laws; for not only is there a frequent disregard of all scientific principles in the construction of the patents, but in many cases there is also a total disregard, or else profound ignorance, of what has already been done in the matter. Repetitions, therefore, occur again and again of the same process, nearly always imperfectly specified; and, on the other hand, the most ridiculous propositions often assume an importance as if for no other object than that of obstructing invention. Out of the 121 patents for the preservation of food which I have had an opportunity of examining, there are hardly a dozen that can be regarded as either useful to the community or profitable to the patentee.

(To be continued).

Cheap Magnesium.—A writer in the *Builder* says:—"There is now a fair prospect of a reduction in the price of magnesium through some recent improvements in its manufacture, and it is probable that in the course of next year we shall see the metal retailed at or under one shilling per ounce."

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 3, 1868.

Dr. Warren de la Rue, F.R.S., President, in the chair.

The minutes of the previous meeting were read and confirmed.

The President announced that the council had that evening adopted a resolution which would, it was believed, tend to promote scientific investigation. At the present time gentlemen were frequently deterred from the prosecution of interesting investigations by the great expense which they entailed upon the experimenter. To mitigate this difficulty, it was now resolved that a certain sum of money, not exceeding £50, should be set aside annually as a grant fund in aid of original research. Any claims for grants from this fund which were sent in would be investigated by a committee consisting of four members of council. The committee, at whose suggestion the above resolution had been framed, recommended that, except in special cases, each single grant should not exceed £10, and furthermore that the application of the fund should not be limited to Fellows of the Chemical Society. It was, however, believed that Fellows of the Royal Society, having the advantage of a grant fund of their own, would not be likely to apply to the Chemical Society. In accordance with this resolution, gentlemen who wished to presecute researches were now invited to apply in writing to the secretary for grants. It was, of course, to be understood that results obtained with the assistance of such grants must be communicated, in the first instance, to the Chemical Society.

The list of donations was then read, and the following certificates were read:—For the first time, Mr. F. W. Hart, Mr. S. Williams, Mr. J. W. Allen, Mr. E. K. Muspratt; for the second time, Mr. J. Hughes, Mr. T. Rowan, Mr. W. W. Stoddart; for the third time, Mr. E. J. Tosh, Mr. G. R. Gowland.

The last-named gentlemen were then ballotted for, and were declared duly elected.

Professor Wanklyn then described his "*Researches on the Action of Sodium on the Ethers of the Fatty Acids.*"

Professor Wanklyn said that he began to experiment on the action of sodium on the ethers of the fatty acids about seven years ago. The first notice of these experiments was published in 1864. Other notices were published at the meeting of the British Association in 1867 and at the meeting this year, and the last notice has just appeared in the *Philosophical Magazine* for December.

The result of the whole investigation is that the ethers are resolved into two parts by the action of sodium, viz., into peroxide of the alcohol-forming radical and into acid-forming radical. Acetic ether, for example, is broken up into—

C_2H_5O = peroxide of ethyl
and C_2H_3O = acetyl.

The peroxide of the alcohol-forming radical is always found in the state of combination with sodium. The acid-forming radical is sometimes found isolated and sometimes in combination with sodium. An example of the former occurs in the case of valerianic ether, from which free valeryl and ethylate of soda have been obtained. Examples of the latter have been yielded by valerianic ether, which, on gentle treatment with sodium, gives sodium-valeryl and ethylate of soda, and also by acetic ether from which sodium-triacetyl, $(C_2H_3O)_3Na$, and ethylate of soda have been obtained.

The speaker exhibited a specimen of polyvaleral, $n(C_5H_{10}O)$ obtained by treating sodium-valeryl with water—

$$n(C_5H_9ONa) + n(H_2O) = n(C_5H_{10}O) + n(NaHO).$$

Its boiling point is about 215° C., and its smell is very bad. Indeed, as was remarked, one of the difficulties of the investigation was the badness of the smell of this product.

Hydride of triacetyl $H(C_2H_3O)_3$, had also been prepared. It is an oil, somewhat heavier than water, and possessing a very curious, but not disagreeable, smell.

A number of chemists (Geuther, Greiner, Brandes, Frankland and Duppa) have also made recent investigations of these reactions, and arrived at different results. According to these chemists the reaction between sodium and these ethers is of a very complicated kind. Thus Geuther gives—

$$2C_4H_8O_2 + Na_2 = C_6H_9NaO_3 + C_2H_5NaO + H_2,$$

and Frankland and Duppa give essentially the same account of the reaction.

This equation is, however, invalidated by the fact that the evolution of hydrogen required by it does not occur. Old experiments of Lowig's and Schweitzer's, bearing date 1840, describe the action of potassium on acetic ether as taking place without evolution of hydrogen, and recent experiments of the author's* have shown that the reaction between acetic ether and sodium takes place without evolution of an equivalent of hydrogen.

It being, therefore, established that the formation of the compound, $C_6H_9O_3Na$, from acetic ether and sodium takes place without evolution of hydrogen, there is no other way of representation but the one given by the author.

Professor **Williamson** enquired whether the author had taken care to work under the same conditions as Frankland and the other chemists quoted had employed. For example the author had recently described some experiments—the action of sodium on valerianate of ethyl—in which common ether was employed as a solvent. Frankland had not used ether, and it was obviously conceivable that without ether the results obtained might be different.

Professor **Wanklyn**, in reply, said that although ether had been employed in some cases, the experiments upon which most reliance was placed were performed without it, and in strict accordance with the methods used by previous workers. The only difference had been that he had measured the gas obtained.

"*On some Compounds of Phosphorus containing Nitrogen*," by J. H. Gladstone, PhD., F.R.S.

Three series of phosphoric amides had already been described, and the object of the present paper was to group together a number of other new compounds which had from time to time been examined during the investigation.

Amidated Oxychlorides of Phosphorus.—Oxychloride of phosphorus, at a temperature of 0° C., was found to absorb about 22 per cent of ammonia gas, and at a higher temperature about 44 per cent. In either case a white solid mass was produced, which was believed to be a mixture of amidated oxychloride of phosphorus and chloride of ammonium. The amount of ammonia absorbed corresponded closely with that indicated by the following formulæ:—

$$PCl_3O + 2NH_3 = PCl_2(NH_2)O + NH_4Cl.$$
$$PCl_3O + 4NH_3 = PCl(NH_2)_2O + 2NH_4Cl.$$

The author made various unsuccessful attempts to separate the amidated compounds from the chloride of ammonium. No suitable solvent could be found, for water and alcohol both produce decomposition. The nearest approximation was obtained by the use of a mixture of alcohol and water. It appeared probable that the lower amide was capable of transforming itself slowly into the higher one—

$$2(PCl_2NH_2O) = PCl(NH_2)_2O + PCl_3O.$$

The author states that he has never succeeded in forming such a substance as Schift's phospho-triamide.

Phosphonitryle, PNO, was formed when the above mentioned mixtures of amidated oxychlorides of phosphorus and chloride of ammonium were strongly heated. It was a white amorphous substance, fusing at a bright red heat, difficult of decomposition, and incapable of combining with acids or bases. It had been previously described under various names. Gerhardt called it biphosphamide, but this name appearing inappropriate, the author suggested that of phosphonitryle.

Pyrophosphonitrylic Acid.—The late Mr. J. D. Holmes had described in his note-book the formation of a series of bodies having the composition of pyrophosphonitrylates by the action of heat upon pyro-triamates. His analyses were very satisfactory, but the present author had not succeeded in obtaining the same results. He, however, thought it right to publish those which Mr. Holmes had obtained. Pyrophosphotriamate of potassium, when heated, yielded ammonia and pyrophosphonitrylate of potassium, according to the following formula:—

$$P_2N_3H_6KO_4 = P_2NKO_4 + 2NH_3.$$

From the last-named compound the silver and copper salts were prepared, and their analyses gave results which corresponded pretty well with those given by theory. The ammonium salt was also prepared by heating pyrophosphotriamic acid, but the acid was not isolated. The formula of the latter should be $PNHO_4$.

Action of Heat on Terammoniated Tetraphosphopentamic Acid.—This semi-fluid acid, at 100° C., yielded ammonia, and a white mass consisting chiefly of pyrophosphamate of ammonium. At a higher temperature, some pyrophosphotriamic acid was also formed. At a uniform temperature of about 220° C., ammonia was evolved, and a white solid remained, from which cold water extracted pyrophosphodiamic, and perhaps, also, tetraphospho-tetramic acids. The residue was found, by analysis, to agree with the formula PNH_4O_3, but this formula should probably be doubled, if not quadrupled.

Tetraphosphotetrimic Acid.—The silver salt of this acid was formed, as had been previously shown, by the action of nitrate of silver on tetraphospho-pentazotic acid. It had subsequently been ascertained that this formation was attended with an increase of weight of 50·1 per cent. It was therefore probable that the reaction by which the imic acid was produced was the following:—

$$P_4N_5H_9O_7 + 2AgNO_3 = P_4N_4H_4Ag_2O_7 + NH_3 + 2HNO_3,$$

which involved an increase of 62·5 per cent.

If the tetrimic acid, $P_4(NH)_4H_2O_7$, had existed in the original compound in combination with $P_4N_6H_{12}O_7$, only about half as much silver salt should have been produced.

Other bodies, of composition analogous to those which had already been described, might doubtless be prepared. Indications of the existence of some of them had, indeed, been actually obtained, but their investigation was attended with great difficulty.

Professor **Odling** pointed out the advantage which might sometimes be gained in class teaching by writing the double atom of ammonia as an amide of ammonium, NH_4NH_2. The action of ammonia upon oxychloride of phosphorus, which Dr. Gladstone had investigated, was perfectly parallel with that by which white precipitate was produced, and both might be simply represented by the use of such a formula for ammonia:—

$$HgCl_2 + NH_4NH_2 = HgNH_2Cl + NH_4Cl,$$
$$POCl_3 + NH_4NH_2 = PONH_2Cl_2 + NH_4Cl.$$

In a similar manner, writing at random such a formula as $CxHxClO$, it was easy to show that the following reactions were analogous to one another:—

$$CxHxClO + KCy = CxHxCyO + KCl.$$
$$CxHxClO + NH_4Cy = CxHxCyO + NH_4Cl.$$
$$CxHxClO + NH_4NH_2 = CxHxNH_2O + NH_4Cl.$$

The Society then adjourned until Thursday, Dec. 17.

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* See Chemical News, vol. xviii., p. 143.

NOTICES OF BOOKS.

"*A Manual of Elementary Chemistry, Theoretical and Practical*," by George Fownes, F.R.S., late Professor of Practical Chemistry in University College, London. Tenth edition, revised and corrected. London: John Churchill and Sons, New Burlington Street, 1868.

There is probably not a student of chemistry in this country to whom the admirable manual of the late Professor Fownes is unknown. It has achieved a success which we believe is entirely without a parallel among the scientific text-books in our language. This success has arisen from the fact that there is no English work on chemistry which combines so many excellences. Of convenient size, of attractive form, clear and concise in diction, well illustrated, and of moderate price, it would seem that every requisite for a student's handbook has been attained.

We have before us the ninth edition published in 1863, with which to compare the tenth edition which has just been placed in our hands. The ninth edition was published under the joint editorship of Dr. Bence Jones and Dr. Hofmann, the new one has been superintended through the press by Dr. Bence Jones and Mr. Henry Watts.

It is not too much to say that it could not possibly have been in better hands. Dr. Bence Jones has been connected with this work as editor since the third edition published in 1850, and it is evident that the task of watching over its subsequent editions has been a labour of love. The name of Mr. Watts now appears in the work for the first time, but it needs no great prophetic powers to foresee that his connection with it will not cease with the present issue. There is no one in England who can compare with Mr. Watts in experience as a compiler in chemical literature, and we have much pleasure in recording the fact that his reputation is well sustained by this, his last undertaking. The ninth edition of "Fownes" contained 820 pp.; the tenth contains 1020 pp., and is probably as bulky as it is desirable that a student's text-book should ever be.

The opening chapters on "Density and Specific Gravity," remain pretty much in the state in which they were in the ninth edition; the chapter on "Heat," however, is much altered: Regnault's important experiments on the amount of heat requisite to convert water of any given temperature into steam of the same or another given temperature have been noticed, and Fahrenheit's scale has been in many places discarded for the centigrade. A table exhibiting the melting points of several substances, and their latent heats of fusion, "expressed in gram-degrees," has been introduced, and will be found useful. Under the head "Sources of Heat" Joule and Meyer's researches on the mechanical equivalent of heat have been explained clearly and concisely, and, altogether, this section has been greatly improved.

The article "Light" has also been increased by additional matter on the interesting subject of absorption spectra.

When we come to the chemistry of elementary bodies we see at once in the section on oxygen, that the work before us has undergone a radical change—a change rendered absolutely necessary by the universal adoption of the new notation in all chemical schools of any importance. Ozone is also noticed at much greater length in this edition.

Under hydrogen we were much pleased to find that the important phenomena of occlusion, studied by Deville and Troost, and Graham, have been done justice to. The beautiful experiment by which the latter chemist obtained hydrogen from the meteoric iron of Lenarto is described in this place. To show how carefully the work has been edited, we may mention that the plate of curves indicating the solubility of salts in 100 parts of water, has been re-engraved, in order that the names of the salts may be in harmony with the nomenclature adopted throughout the work.

As may be supposed, the article "Carbon" has been almost entirely re-written to bring it into accordance with the new views; moreover, the article on "Combustion and the Structure of Flame" is made to occupy its natural place after "Carbon," instead of being separated from it as in the ninth edition.

We need not say that the well-known section on "The General Principles of Chemical Philosophy" has been re-written and much extended. In the ninth edition this subject was condensed into twenty-one pages; in the one before us it occupies thirty-one pages, and it is one of the best expositions in our language of the views at present received.

In passing we may mention as showing the strides that have been made even in metallic chemistry, which certainly does not progress like the chemistry of the compounds of carbon, that the article "Thallium" which, in the ninth edition, was condensed into less than one page, in that before us occupies five pages, and takes its place under "Triad Metals," the metals being grouped in accordance with their atomicity, as monads, dyads, triads, tetrads, pentads, and hexads.

As may be expected, it is when we come to the organic chemistry that the most sweeping changes are manifest. In fact, here we can scarcely recognise our old friend "Fownes." The limits of this notice preclude the possibility of recapitulating all the changes that have taken place. The whole system has been re-modelled to keep pace with the rapid strides which organic chemistry has made. As we wish our readers to see clearly the admirable and conscientious manner in which the editorial work has been accomplished, we have endeavoured to find a characteristic article for quotation, and we cannot do better than draw their attention to the section on "Classification of Organic Compounds—Organic Series."

"The classification of organic compounds is based upon the equivalence or atomicity of carbon. This element is a tetrad, being capable of uniting with at most four atoms of hydrogen or other monatomic elements. Methane, or marsh gas, CH_4, is, therefore, a saturated hydrocarbon, not capable of uniting directly with chlorine, bromine, or other monad elements, but only of exchanging a part or the whole of its hydrogen for an equivalent quantity of another monad element. It may, however, as already explained (p. 257), take up any number of dyad elements or radicals, because such a radical introduced into any group of atoms whatever neutralises one unit of equivalency, and adds another, leaving, therefore, the combining power or equivalence of the group just the same as before. Accordingly, the hydrocarbon, CH_4, may take up any number of molecules of the bivalent radical, CH_2, thereby giving rise to the series of saturated hydrocarbons—

$$CH_4, C_2H_6, C_3H_8, C_4H_{10} \quad . \quad . \quad . \quad . \; C_nH_{2n} + 2.$$

A series of compounds, the terms of which differ from one another by CH_2, is called a homologous series.

There are many such series besides that of the hydrocarbons just mentioned; thus methyl-chloride, CH_3Cl, gives, by continued addition of CH_2, the series of chlorides—

$$CH_3Cl, C_2H_5Cl, C_3H_7Cl, C_4H_9Cl, \quad . \quad . \quad . \; CnH_2n+1Cl;$$

and from methyl-alcohol, CH_4O, is derived in like manner the series of homologous alcohols—

$$CH_4O, C_2H_6O, C_3H_8O, C_4H_{10}O \quad . \quad . \quad . \; CnH_2n+2O.$$

The terms of the same homologous series resemble one another in many respects, exhibiting similar transformations under the action of given reagents, and a regular gradation of properties from the lowest to the highest; thus, of the hydrocarbons, $CnH_2n + 2$, the lowest terms CH_4, C_2H_6, and C_3H_8, are gaseous at ordinary temperatures, the highest, containing 20 or more carbon-atoms, are solid, while the intermediate compounds are liquids, becoming more and more viscid and less volatile as they contain a greater number of carbon-atoms, and exhibiting a constant rise of about 20° in their boiling points for each addition of CH_2 to the molecule."

The general character of this edition may be judged of from the above extract, and we consider that, as the work now stands, the student has clearly laid before him all the leading facts and theories as at present received.

A careful examination of the details of the descriptions of individual substances, as may be expected, reveals some omissions and inaccuracies, which will, doubtless be corrected in subsequent editions; thus insolinic acid does not occur in the index to the ninth edition, but, in this edition, when its existence as a product of the oxidation of cumic acid has been clearly disproved by the researches of De La Rue and Müller, it is not only to be found in the index, but at p. 786 it forms a separate article, and Hofmann's process is given as yielding it, although in Watts's "Dictionary," under the head "Terephthalic Acid," this method is stated only to give terephthalic acid.

Again, in the ninth edition, oil of rue is said to consist principally of $C_{11}H_{22}O$, which is probably correct; but in the tenth edition it is said that "rue oil contains capric aldehyde, $C_6H_{12}O$;" whereas capric aldehyde is $C_{10}H_{20}O$, and not $C_6H_{12}O$. The formula $C_6H_{12}O$ would represent the aldehyde of caproic acid.

On looking for "oil of cloves" in the index of the ninth edition we do not find any mention of it, nor under the head "cloves," nor under "eugenic acid;" the same omissions occur in the tenth edition, where the only mention of eugenic acid that we have been able to see is under the head "eugetic acid," where we find that eugetic acid is produced by the action of carbon dioxide and sodium on eugenic acid.

These are, however, but trifling blemishes in so admirable a work; and we consider that students of chemistry are under a deep obligation to the editors for the skill and care with which they have fulfilled a difficult task.

CORRESPONDENCE.

GMELIN'S CHEMISTRY.

To the Editor of the Chemical News.

Sir,—I observe, in Williams and Norgate's "Scientific Book Circular," issued this month, a notice of two supplementary volumes to Gmelin's "Handbook of Organic Chemistry," by Husemann and Kraut, published at Heidelberg, 1867-68. Will the publication of these volumes have any effect in expediting the issue of the remaining volumes of the English edition, so long promised by the "Cavendish Society?"

The completion of Watts's Dictionary certainly, to a great extent, removes the blank made by the want of the remaining volumes, and specially by the want of a general index; but all are not so fortunate as to possess or have at their command such a costly work as "Watts," and not many of those who have "Gmelin" will care to add another work of such magnitude to their library, especially when the two works are as it were contemporaneous, and when their chemical contents are consequently so closely akin. In the statement last made by the Council to the subscribers, I think it was said that the funds then on hand were considered sufficient to bring the work to a close, if the remaining portion of the German edition did not exceed their expectation. If it has, the subscribers should be called upon at once, to aid, as far as is requisite, in bringing to a successful termination a work which I feel satisfied has no equal, and no rival but Watts's "Dictionary of Chemistry."—I am, &c.,

J. B. Johnstone.

Glasgow.

CHEMISTRY IN THE EXAMINATIONS OF THE DEPARTMENT OF SCIENCE AND ART.

To the Editor of the Chemical News.

Sir,—In the "syllabus" of the subjects which are expected to be *taught* and *learned* in the first, or elementary division of chemistry, which the Department of Science and Art has lately issued for the information of teachers, I see specified, amongst other matters, "the preparation and properties of hydroxyl." Now I will venture to say that not one teacher out of ten for whom this syllabus is intended ever heard of "hydroxyl," and that of the nine who have not so heard, and who may be desirous of clearing up their ignorance on the subject, not more than one is likely to be able to obtain any information with regard to it from the ordinary manuals which are at the command of most teachers, and which, as a rule, ignore "hydroxyl" altogether.

It seems to me that it would be well if the Privy Council would follow the example set by the University of London, and appoint their examiners for a stated term of office; and also that they should take care that candidates are not compelled to learn theoretical views which are entertained only by their examiners, and which the progress of science may probably in the course of a few years demonstrate to have been entirely erroneous.—I am, &c.,

A Teacher.

BATHS FOR CONSTANT TEMPERATURES.

To the Editor of the Chemical News.

Sir,—I have only just read your Paris correspondent's letter of Nov. 25th. He therein reviews a communication from M. Vogel, in which that gentleman proposes the substitution of glycerine for oil when constant temperatures are required above 100° C. Many years back I suggested the use of this bath to Dr. Emerson Reynolds, who, in a communication to your valuable journal, in 1861, brought it before the public (*vide* "Bath for High Temperatures," Chemical News, vol. iv., 1861). I have not the number at hand, but, if I remember rightly, that gentleman gave the temperatures at which the glycerines of commerce boiled.

I have used weak glycerine to great advantage in a chamber in which I dry my precipitates. The few degrees of temperature attained, above the boiling-point of water, wonderfully facilitates the drying of such substances as water residues or hygroscopic matter.—I am, &c.,

Charles R. C. Tichborne.

Laboratory, 40, Mary Street, Dublin,
December 4, 1868.

THE COHESION FIGURES OF LIQUIDS.

To the Editor of the Chemical News.

Sir,—Professor Tyndall, in his lectures on "Physics," at the Royal School of Mines, was the first to represent my cohesion figures of liquids as optical images with good definition, and on a scale sufficiently large for illustrating a lecture. My friend, Professor Miller, urged me to do so, and pointed out the means, when I first showed these figures at the meeting of the British Association at Manchester in 1861. A week after the meeting I visited some friends at Weston-super-mare, and showed the figures to Dr. Pooley, Dr. Tomkins, and Mr. Phillips, a lecturer on experimental science. The last-named gentleman thought it would be easy to represent the figures on a large scale on a screen, and he shortly afterwards did represent the figures of creosote and one or two others by reflecting the light of the electric lamp from the water surface to the screen; but as there was no interposed lens the definition was bad.

Some time about 1862-3, the sister of my friend, the late Professor George Wilson, of Edinburgh, informed me that Dr. Thomas Strethill Wright was much interested in the study of my figures; accordingly I sent him copies of what had been published on the subject. In December, 1864, Dr. Wright gave a lecture on the subject before the Royal Scottish Society of Arts. From a report in the *Scotsman* newspaper it appears that Dr. Wright "illustrated by diagrams, and especially by a series of drawings magnified and projected on a screen by the oxyhydrogen light, the various forms assumed by certain acids and other liquids when dropped on certain surfaces."*

About three years ago, my friend, Mr. Hatcher, late of King's College, devised an apparatus for showing enlarged optical images of my figures on a screen. I have no doubt the apparatus would have answered perfectly, although it was not so simple as that described by Professor Reynolds. I did not get the apparatus made, partly because I thought it would be expensive, and partly because I had no one to manage it for me, and my weak sight makes me shrink from contact with very bright lights.

About two years ago, when I had the pleasure of showing you some of these figures, you were struck with their beauty and distinctness of form, and you remarked that it would not be difficult to arrange the means for their introduction as lecture illustrations.

In 1864 I read a paper before the Society of Arts on "The Verification of Olive Oil by means of its Cohesion Figures." Although dealing specially with one oil, the general principle was gone into, and a large number of coloured diagrams of the figures of other liquids were exhibited. In the discussion that followed the reading of the paper, it was suggested that the figures of genuine liquids and of known adulterations should be collected into a sort of pattern book, and photography was pointed out as the means of production.

I have often thought of the best method of fixing some of these figures, and could not hit upon any satisfactory one. I therefore wait with much curiosity until Dr. Moffat shall publish his mode.

Some of the most rapid but well defined figures, ether for example, cannot, I imagine, be fixed by Dr. Moffat's process. And yet it is important to be able to do so, for photographers complain often of the quality of the ether supplied to them, and tell me it would be of importance if they could try it by so ready a method as the cohesion figure test. I tell them that nothing is easier, for they have only to draw up a little ether into a dropping tube and deliver it, drop by drop, with a steady hand to the surface of water. "Yes," they object, "that may be easy; but we want an accurate representation of the standard figure for the sake of comparison."

In February, 1864, I read a paper before the Pharmaceutical Society on "The Verification of Castor Oil and Balsam of Copaiba by means of their Cohesion Figures." I thought these two liquids would be interesting to chemists and medical men, since the balsam is commonly adulterated with castor oil, and this renders the alcohol test for the balsam inoperative, since both are soluble in it. The cohesion figure test is well adapted to this case.

My friend, Professor Miller, who saw all my early experiments, urged me, while I was preparing for the British Association at Manchester, to get up a few sharply defined qualitative tests of adulteration by this method. I was able to show that, in an expensive oil, such as that of cinnamon, the presence of five drops per cent of a cheap fixed oil could be detected.

I stated in my first paper that the method failed in the case of dilute solutions. Dr. Attfield was good enough to send me a number of tinctures made with pure spirit and with methylated spirit. I was not able to decide by this method which was which.

At the meeting of the British Association at Bath in September, 1864, I introduced a number of new figures as produced not only on water, but also on various oily and fatty surfaces; also a new variety named submersion figures, formed by allowing a drop of some liquid to descend in a column of another liquid. Some of the figures thus produced are wonderfully complex, yet perfectly definite. Professor Maxwell told me that he produced some of them by allowing a liquid to fall from a height, as from a window, and looking up at it from below.

I have heard that cohesion figures are just being made use of by the pattern designers for calico printing, &c. It is astonishing how long it takes for a scientific idea to germinate into practical fruit. In my first communication to the British Association at Manchester, in the very centre of pattern designing art, where we would suppose the artists were constantly on the watch for suggestions, this prolific suggestion was thrown out, and has been left alone during seven years. In my second paper in the *Philosophical Magazine* for March, 1862, I repeated the suggestion as follows:—"Many of these cohesion figures are calculated to give hints to the pattern designer. I have shown these figures to artists, who pronounce some of them to be 'perfect beauty,' and agree with me that numerous shawl and other patterns, fringes and borders of great novelty and effect, both as to form and colour, might be got up from a study of these figures."

I have been told that I have not made enough of so very attractive a subject as these figures would form for public exhibition, &c. As already stated, and for the reasons assigned, I have not sought opportunity of exhibiting them before an audience. The pleasure of having discovered and investigated these figures is enough for me; I leave to others their exhibition and practical application. Having carried the subject as far as my intelligence allowed me, I yearned for fresh objects of inquiry, and soon became interested in studying the physical properties of camphor and afterwards the whole subject of supersaturated solutions, on which you have already reported some of my results.—I am, &c.

Charles Tomlinson.

Highgate, N., Dec. 5, 1868.

PS.—Since writing the above, Professor Woodward, of the Midland Institute, has informed me that he has arranged an apparatus for showing the figures on a large scale at a public *soirée* at this Institute.

MISCELLANEOUS.

The University of Edinburgh.—Owing to Dr. Lyon Playfair having been elected member of Parliament for the Universities of Edinburgh and St. Andrews, he has decided to resign the chair of chemistry in the University of Edinburgh.

Apothecaries' Hall.—We have much pleasure in announcing that Mr. Alexander Y. Stewart, formerly assistant to Professor Anderson, of Glasgow University, has been appointed to the post of Chemical Operator to the Company.

University of London.—The following gentlemen have passed the B.S. pass examination:—Anderson, Tempest, B.Sc. University College; Langmore, John Wreford, University College; Poore, George Vivian, University College; Ridge, John James, B.A., B.Sc., St. Thomas's Hospital. *Examination for Honours.*—First Class. Ridge, John James (Scholarship and Gold Medal), St. Thomas's Hospital; Poore, George Vivian (Gold Medal), University College; Anderson, Tempest, University College; Langmore, John Wreford, University College.

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* In Chambers's "Encyclopædia," (art. "Cohesion Figures)," Dr. Wright gives some account, with illustrations, of my cohesion and submersion figures, and also a description and engravings of some figures of his own, which he calls "Breath-cohesion and Electric Cohesion Figures."

Royal Institution of Great Britain.—Christmas Lectures.—A course of six lectures (adapted to a juvenile auditory) "On the Chemical Changes of Carbon," will be delivered by William Odling, Esq., M.B., F.R.S., Fullerian Professor of Chemistry in the Royal Institution, on the following days, at three o'clock:—Lecture I., Tuesday, Dec. 29th, 1868; II., Thursday, Dec. 31st, 1868; III., Saturday, Jan. 2nd, 1869; IV., Tuesday, Jan. 5th, 1869; V., Thursday Jan. 7th, 1869; VI., Saturday, Jan. 9th, 1869. *Subjects of the Course*:—Change from marble or limestone to carbonic gas, and from carbonic gas to charcoal. Reverse change from charcoal to carbonic gas, and from carbonic gas to limestone. Nature of the change from charcoal to carbonic gas. Carbonic gas, and consequently charcoal, a constituent of the air. Artificial changes of coal, wood, peat, and bone, into charcoal. Curious changes of other substances brought about by charcoal. Use of charcoal to effect the purification of air and water. Changes of charcoal from one form to another. Changes of charcoal into various substances. Strange properties of the substances formed by union of charcoal with oxygen, with sulphur, and with hydrogen. Charcoal the chief constituent of wood and vegetable tissue. Burning of charcoal and wood as fuel, to furnish heat. Change of burnt wood and charcoal into carbonic gas. Unburning of carbonic gas into wood and charcoal. Heat, furnished by the burning of wood and charcoal, traceable to the sun.

The Tinning of Saucepans.—In France, as in other parts of the Continent, the use of copper saucepans is very far more general than it is in England, and great care is generally taken to keep them in good order. In all well-conducted houses copper vessels are tinned frequently, and cooks are thoroughly impressed with the danger accruing from neglect in this respect. The police regulations require that nothing but pure tin should be used, but that metal is dear, while lead is cheap, and therefore a mixture of the two metals is too often made use of. The mixture works well, but when the lead forms a considerable part of it the vessels become decidedly dangerous. In consequence of information obtained and suspicions entertained, the Minister of War ordered an inquiry to be made into the subject by the directors of the military hospitals. The result of this inquiry has been read before the Academy of Medicine, and brings out the startling revelation that some manufacturers of copper utensils and tinners mix 25, and in some cases 50, per cent of lead with the tin, and that, in addition to this, antimony, another dangerous metal, is added. From the facts thus brought to light, M. Gobley, a member of the Academy of Medicine, has drawn up the following list of recommendations:—1. That the metal used to line copper drinking vessels shall not contain more than 1 per cent of lead. 2. That not more than 5 or 6 per cent of lead be mixed with the tin used for saucepans or other cooking vessels, that amount offering no serious danger. 3. That every maker shall be required to mark his productions with a special stamp. 4. That the travelling tinmen shall be strictly watched.—*Journal of the Society of Arts.*

How Popular Science is Written.—In a letter on "Poisonous Dyes," recently sent to the *Times*, commenting on the highly explosive nature of the dye which was supposed to be used, Mr. Crookes wrote—"It is almost as explosive as nitroglycerine, and has already destroyed one factory, with loss of several lives. Should the dye retain this character in the fabric, the wearers of these socks would be able to vary the excitement they are now indulging in in a highly sensational manner." This harmless little jokeling, perpetrated two months ago, has this week been disinterred by the editor of a contemporary which occasionally dabbles in popular science, and now appears in the following shape:—"Mr. Crookes has recently asserted that woollen stockings dyed with picrate of potash are liable to explode on the feet of those who sit too near the fire."

MEETINGS FOR THE WEEK.

Monday.—Medical, 8.
— London Institution, 6. Mr. Rodwell on "Heat Treated as a Science of Kinetics."
Wednesday.—Society of Arts, 8. Dr. B. H. Paul, "On Artificial Freezing."
Thursday.—Royal, 8½.
— Zoological, 4.
— Chemical, 8.
Friday.—Quekett Club, 8.

TO CORRESPONDENTS.

R. Gregson.—You can have no better dictionary than Watts's.

E. J. M.—Received, with many thanks.

E. H.—After ignition sesquioxide of iron will be very difficultly soluble in nitric acid.

Cartilage.—The query should have been addressed to a medical paper. It is not a chemical problem to ascertain the average growth of a female between the ages of 17½ and 21.

F. J. Griffin.—We consider it is scarcely appropriate to our pages.

Communications have been received from J. B. Johnstone; E. J. Mills; R. Gregson; G. F. Rodwell (with enclosure); L'Abbé A. Hamy; T. Hill; J. H. Pepper; E. A. Bird; Dr. Bond; J. Samuelson; D. Forbes, F.R.S.; C. Tomlinson, F.R.S.; R. C. Menzies; P. LeNeve Foster; F. J. Griffin; S. Reeve (with enclosure); J. F. Rutter; E. W. Streeter; R. M. Rew; Dr. Hermann Weber; Dr. S. Macadam (with enclosure); A. Syers; J. Williams; P. Squire; F. M. Jennings (with enclosure); W. Hunter; J. Thomson; Dr. H. M. Noad, F.R.S.; E. P. H. Vaughan; Paul Curie (with enclosure); H. Rastrick (with enclosure); and M. Murphy (with enclosure).

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Mr. J. C. BRAITHWAITE, for thirteen years Principal Instructor in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c., wishes to inform his old Pupils and others that he continues to devote his whole attention to Education.

The Session 1868—1869 will commence on the 1st of October, when Mr. BRAITHWAITE'S Laboratory, which has been enlarged, will be re-opened at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS meets as usual every Monday and Thursday Evening, at 8 p.m., commencing October 1st.

The LATIN CLASS for the reading of the Pharmacopœia, Physicians' Prescriptions, &c., every Tuesday and Friday Evening, at 8 p.m., commencing October 2nd.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday Evening, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday until further notice.

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Letters of inquiry should be accompanied with a stamped envelope. Address, 54, Kentish Town Road N.W.

Mr. Braithwaite receives a few Pupils to board in his house.

THE CHEMICAL NEWS.

Vol. XVIII. No. 472.

ON THE

CHEMISTRY OF SUGAR MANUFACTURE AND SUGAR REFINING.*

By Dr. WALLACE, F.R.S.E., F.C.S.

About eight years ago I had the honour of delivering a discourse to the members of the Philosophical Society of Glasgow "On some Points in the Chemistry of Sugar Refining." Since that time the sugar-refining trade of this country has undergone great changes. The Clyde houses have increased to nearly three times the amount of their former production, while in London, formerly the principal seat of the manufacture, many of the refineries have altogether ceased working, while others are doing but little business. The Greenock sugar is now sold in nearly every considerable town in Great Britain and Ireland, and it is a fact that raw sugar has been purchased in London and in Liverpool, refined in Greenock, and sent back again to the place it came from. The English ports, especially London and Liverpool, possess great advantages so far as the purchase of the raw material is concerned; but Greenock has other circumstances in her favour that more than counterbalance these advantages. In Greenock we have cheap ground, cheap labour, cheap coals and water, not only very moderate in price, but of a quality remarkably well adapted for refining purposes, while the re-burning of charcoal is not regarded as a nuisance. The same favourable circumstances exist also, although to a less extent, in Glasgow; and it appears highly probable that but for the want of a good raw-sugar market, the refining trade would soon be in a great measure confined to the Clyde. There cannot be a doubt that the Greenock refiners have exhibited during the last ten or twelve years extraordinary enterprise, and have taken the lead in the introduction of improvements, both mechanical and chemical, while, on the other hand, they have rejected various innovations which have turned out miserable failures. The Greenock refiners have, however, been poorly repaid for their energy, perseverance, and skill; the extraordinary competition between the different firms has made it difficult to find an outlet for the produce, while the French and Belgian system of duties on the raw sugar, and drawback, as it is called, upon the refined when exported, operate against them in common with all other British refiners. I shall refer to this subject by and by; but in the meantime shall merely state briefly that the Governments referred to offer a premium to their refiners to export their produce—they charge a duty on the raw sugar, and on the refined being exported give a drawback amounting to considerably more than the duty that was paid. A direct result of this unfair competition is that loaf sugar cannot now be made profitably in this country, and that branch of the trade may almost be said to have ceased.

In the production of crushed sugar an immense impetus has been given by the introduction of the centrifugal machine for draining the syrup away from the crystals; not the least of the advantages being the extremely rapid return of the sugar in a marketable form, it being possible to have the refined product ready for sending out in thirty-six hours from the time the raw sugar was "blown up." The whole system of refining has undergone a great change: a much greater quantity of charcoal is now used than formerly, and it is much more frequently renewed, and there is now very little of extremely low sorts manufactured, the production being mostly confined to two kinds, whites and yellows. Another innovation is boiling down to "a jelly" as it is technically called—that is, without graining in the pan; and the pans are so much improved by very wide necks to permit the free escape of the steam, extensive heating surface, and great condensing power, that a panful of the largest size may be boiled down in two or three hours and at a temperature ranging from 50° to 55° C. (122° to 131° F.). Another alteration of the system—I can scarcely call it an improvement, although I suppose it is now necessary in order to make ends meet—is the practice of "in and in" working, whereby no syrup is ever turned out, but the whole produce leaves the house, as it came in, in the form of sugar. In former times—that is, six or eight years ago, the raw sugar being dissolved and decolourised, yielded a liquor which, on boiling down, gave a crop of crystals of white, or nearly white, sugar called "lumps," and a syrup called technically "green syrup." This green syrup was again boiled down, and gave a second crop of crystals called "pieces," and a syrup which was either sold as "golden syrup" or boiled down again to obtain a further quantity of sugar. In any case the ultimate result was that the accumulated salts and other impurities of the raw sugar, so far as they were not extracted by the charcoal, were got rid of in the golden syrup. At the present time the Greenock houses, as a rule, turn out no syrup; in other words, the impurities referred to are carried out of the sugar-house in the yellows, these being purposely made with a very small grain so as to carry a large quantity of syrup. These are, in few words, some of the more salient features of the present system as distinguished from that existing only a very few years ago; but there are also very great improvements in many particulars, such as in the purchase of raw sugars, the chemical examination from time to time of the charcoal as well as the various products of the refinery, and an intelligent scientific supervision of the whole process, which contrasts strikingly with the rule-of-thumb system of former times.

In the preparation of the raw material, considerable changes have occurred. The most notable of these in regard to cane sugar, is the system of Mr. Fryer, of Manchester, by which the cane juice is boiled down, or rather evaporated, very rapidly by exposing it to heated air in a very thin stream running over an inclined plane by means of which a result is obtained which becomes solid on cooling, and is imported into this country under the name of "concrete." In the beet sugar manufacture the "carbonatation" process has been followed out to a considerable extent, and, in fact, is becoming universal. This consists in the addition to the juice of a rather large quantity of lime, which is afterwards separated by a current of carbonic acid gas. A peculiar vacuum pan is employed for the evaporation of the weak syrups, three pans being arranged in one connection, the steam of the first being made to heat the second, and the steam of the second the third. This is called the "triple effet," and is now very generally employed.

Having briefly introduced the subject, I shall now proceed to consider, in greater detail, the various branches into which it may be divided; premising, however, that for the sake of making the whole matter connected, and, to some extent, complete, it will be necessary to mix up with a little that is new a great deal with which many of you are already very well acquainted.

Varieties of Sugar.—Of the many varieties of sugar known to chemists two only, so far as I am aware, are concerned in sugar refining, viz., cane sugar and fruit sugar, but we may also take into our catalogue that kind known as grape or starch sugar. The three varieties contain respectively the following quantities of carbon, hydrogen, and oxygen:—

Cane sugar or sucrose	$C_{12}H_{22}O_{11}$.
Fruit sugar or fructose	$C_{12}H_{24}O_{12}$.
Grape or starch sugar, or glucose	$C_{12}H_{24}O_{12},2H_2O$.

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* Read at the Meeting of the Chemical Section of the Philosophical Society of Glasgow, Dec. 7, 1868.

Fruit sugar and glucose were formerly confounded together, but they have been clearly shown to be quite distinct, as much so as cane sugar and fruit sugar, but fruit sugar is clearly intermediate between sucrose and glucose, which last is the ultimate result of the action of acids, heat, and ferments upon all other forms of sugar, as well as upon the other members of the amylaceous group. In all these changes there is simply the assimilation of the elements of water. Very weak acids, with the aid of heat, effect the conversion of cane sugar, first into fruit, and then into grape sugar; an elevated temperature alone, in presence of water, accomplishes the same transformations, but less rapidly. The following experiments, made with a solution of pure sugar in distilled water, illustrate well the danger of keeping syrups at a high temperature for a lengthened period of time:—In the first experiment a quantity of the syrup was heated to about 90° C. (194° F.) until a large proportion of the sugar crystallised out; more water was then added, and the evaporation and solution repeated several times. A thick syrup was at last obtained, which refused to give any crystals when kept for weeks over oil of vitriol. Analysis showed the mixture to contain cane and fruit sugar in the proportion of one of the former to fourteen of the latter. In the next experiment the syrup was kept for several months in one of the floors of a sugar house, the temperature of which varied from 32° to 38° C. (90° to 100° F.), water being from time to time added. A thick, almost semi-solid, syrup was thus obtained, which did not show the slightest appearance of crystals even under the microscope. It contained 1 part of cane sugar to 10 of fruit sugar. The syrup was left exposed in the same vessel for some time afterwards without undergoing any apparent change, when suddenly the whole was transformed into a soft solid mass, consisting of microscopic, but distinct, crystals of glucose. Weak acids give rise to the formation of grape sugar; but this change does not appear to begin until all the cane sugar has first been converted into fructose. I have never observed crystals of glucose in any of the ordinary products of the sugar house. Heavy syrups and treacle contain generally minute crystals, but the microscope shows these to be cane sugar, the angles being as sharply defined as in sugar candy. Fruit sugar does not crystallise at all, but forms, on evaporation, a tenacious semi-solid mass. This description, however, rather belongs to a mixture of fruit sugar with a small proportion of cane sugar, for as soon as the latter disappears the formation of grape sugar commences. Grape sugar crystallises without difficulty from a tolerably strong solution, provided the latter has not been exposed to too high a temperature.

The natural distribution of the varieties of sugar may be disposed of in a few words. When the sacharine juices are acid, as in grapes and other common fruits, the variety of sugar present is fructose, which changes when the fruits are dried and kept for some time, especially if the skins are ruptured; so that in dried fruits, such as figs and raisins, hard granular masses of glucose are frequently met with; but when the juices are either alkaline or neutral, cane sugar is the variety of saccharine matter present. We have cases in which, in the same plant, at different times, or in different parts of the plant, we have an acid sap containing fruit sugar, and an alkaline sap containing cane sugar. No doubt is entertained by chemists that the sugars play a very important part in the nutrition of plants, and in the vegetable organism there seems to be a perfect facility in the change from cane to fruit sugar or *vice versâ*. Out of the laboratory of the plant, however, it is very different; we can readily change cane to fruit or grape sugar, but the backward operation is one that defies our powers. We have lately seen many wonderful transformations of organic bodies and the artificial formation of compounds hitherto formed only by natural processes, but we have not yet been able to change fructose or glucose into cane sugar, and I, for one, do not expect that it ever will be done.

Cane sugar crystallises readily in four-sided prisms with rhomboidal bases, but the crystals have often a cubical appearance, and sometimes, by truncation, they assume the aspect of six-sided prisms. The crystals are always sharp and well-defined, even when produced from the most impure syrups. Cane sugar is distinguished from all other substances by its intensely sweet taste, which, when the sugar is pure, is unaccompanied by any kind of flavour. As the sensation of sweetness depends very much on the rapidity of solution, it follows that fine-grained sugar which dissolves rapidly in the mouth appears sweeter than large crystals which dissolve slowly, and hence the absurd popular notion that one kind of sugar can be sweeter than another, both being equally pure. Cane sugar is devoid of odour and colour. It is highly soluble in water, which takes up, at the comparatively low temperature of 9° C. (48° F.), about an equal weight. With increase of temperature the power of solution is very much augmented, and at the boiling point of the liquid the capacity of water for dissolving sugar is almost unlimited. At the degree of heat at which syrups are boiled down in the vacuum pan (49° to 54° C., or 120° to 130° F.), water does not by any means possess this power of unlimited solution, and the sugar readily crystallises out if the syrup is not too much loaded with impurities.

Fruit sugar is uncrystallisable, but forms, when dried in vacuo at the ordinary temperature of the air, a gummy semi-solid mass. It possesses a left-handed rotative power on polarised light, from which circumstance it has received the rather clumsy names of "lævulose" and "inverted sugar." I have never found this variety of saccharine matter, as produced artificially, in a pure state, but always more or less mixed with cane sugar. It exists abundantly in golden syrup, molasses, treacle, also in honey, especially when new. Cane sugar refuses to crystallise from a syrup which contains rather more than an equal weight of this variety, and I have found that a syrup which is saturated and which contains less than 8 of cane to 10 of fruit sugar, is absolutely undrainable at any temperature. Here, then, is a serious evil in sugar refining—every pound of fruit sugar destroys the crystallising power of nearly as much cane sugar. With regard to the sweetening power of fruit sugar I cannot give any precise information, as I neglected to ascertain this point when I had an opportunity of examining a nearly pure specimen. Ordinary golden syrup, which contains about 40 per cent fruit sugar and 30 to 35 per cent cane sugar, appears fully sweeter than a solution of pure cane sugar, but it has a certain flavour, and contains alkaline salts which prevent a proper estimate of the sweetness being made. It is stated, however, to be superior to grape sugar, but inferior to cane sugar in sweetening power.

Fruit sugar is more soluble in alcohol than cane sugar, which, indeed, is practically insoluble in absolute alcohol; and this liquid has been proposed for washing crystals of cane sugar for the purpose of freeing them from adhering syrup, without materially affecting the crystals themselves. The experiment succeeds admirably on the small scale, and has long been used on the continent for testing raw sugars, but there are certain difficulties in applying it in actual practice, say upon 50 to 100 tons per day of material. It would be hopeless to use it unless duty-free, on account of its expense, and, besides, it is difficult to obtain a cheap alcohol of such purity that it would not communicate a flavour to the sugar, while methylated spirit is quite inapplicable. Still, I believe that alcohol might be introduced into the sugar refineries of this country for washing raw sugar if it could be had duty free. Of course the sugar would be refined in the usual way afterwards, but the product would be much superior.

Much has been written about the dialysis of impure syrups, and when Professor Graham's paper on dialysis first appeared I tried the process upon golden syrup, but without a satisfactory result. The process has never been applied on the large scale in this country so far as I know, but it has been adopted successfully in some of the continental refineries with beet syrups containing a large quantity of chloride and nitrate of potassium, chloride of sodium, and other alkaline salts, and the efforts of those who have tried it have rather been to separate those salts than to dissociate the cane from the fruit sugar of which beet juice contains only traces. I expected that fruit sugar would have acted as a colloid, and would have refused to pass in any considerable quantity through the dialysing septum, but in this I was disappointed. If time permits I will briefly describe Dubrunfaut's apparatus called the "Osmogene" used for dialysing beet molasses.

Grape sugar, otherwise called starch sugar, or inverted sugar, or lævulose, never occurs in any of the products of the sugar manufacture, so far, at least, as my observations have gone. It crystallises in fibrous masses or tufts radiating from a centre, presenting a very beautiful appearance when examined with a lens. The crystals are said to be cubical, but usually they are minute and indistinct. It is less soluble than cane sugar, requiring about an equal weight of cold water for solution. It is less sweet than cane sugar in the proportion of 2½ to 1. Fruit sugar soon changes to glucose if no cane sugar is present. As I have already stated, we frequently find granular lumps of glucose in raisins and other dried fruits the skins of which have been ruptured. The whiteness and viscousness of old honey is due to the presence of crystals of glucose, while new honey is a clear transparent syrup. I have seen jelly prepared from the juice of currants and other acid fruits and loaf sugar, in which, by too long continued boiling, all the cane sugar had been changed, become opaque and semi-solid from the same cause. This phenomenon must not be confounded with the much more common one of cane sugar forming a hard crisp crust upon the surface of the jelly.

Glucose is largely manufactured in France from potato starch, and more lately in America from Indian corn, and is extensively used by brewers, distillers, and confectioners; but it is not likely to come into use as a sweetening agent, unless it be to adulterate the cheaper kinds of refined sugar; and as these are now sold at about 3d. a pound, there does not appear to be much chance of extensive fraud being practised is this direction.

I have already referred to the action of weak acids in inverting cane sugar, if I may be allowed to use the expression, and may here add that it is of the utmost importance in sugar refining to prevent the occurrence of even the slightest trace of acid, which not only changes the cane sugar more or less into the uncrystallisable variety, but enables the liquors to dissolve iron from animal charcoal or from iron tanks or cisterns, besides other impurities. In this way Mr. Beane's process for treating animal charcoal with hydrochloric acid gas, although otherwise all that can be desired, has entirely failed, and has caused ruinous expense to some refiners who have used it.

Alkalies act but little upon cane sugar (I mean when very dilute) but upon fruit sugar they act energetically, producing glucic acid, and subsequently other compounds of a brown colour. Hence it is that while with beet juice, which contains at most only traces of fruit sugar, a considerable excess of lime may safely be used in clarifying, the same treatment upon cane juice or a solution of common raw sugar produces, on boiling, a dark brown colour.

The action of ferments on sugars, so far as these are concerned in the process of sugar refining, next claim our attention. In my paper of eight years ago this subject occupied a large space, but now I may dismiss it in a few words. The fact is that the duration of the whole process of refining is now so very short that there is little time for fermentation.

In the sugar-house two kinds of fermentation are recognised. The first of these affects chiefly strong or comparatively strong liquors, and communicates to them a peculiar viscidity and ropiness, and the property often seen in treacle and occasionally in golden syrup, of drawing out to a thread of extreme tenuity. This is technically called "smear," from the circumstance that such viscous liquors will never drain away from crystals with which they may be mixed. Frequently sugar-houses have been entirely stopped from the occurrence of smear, which once introduced seems to spread like an epidemic. It appears to be the same kind of action that is so troublesome in the West Indies in making rum from molasses, which is called the viscous fermentation, and which is now prevented by mixing a considerable quantity of sulphuric acid with the liquor while undergoing the alcoholic fermentation. Smear is always the result of filthiness, and may be prevented with certainty by keeping everything about the sugar-house clean and fumigating with sulphurous acid gas. In my paper already referred to, in which this subject is treated of at considerable length, I have ascribed the occurrence and propagation of smear to the action of microscopic vegetable organisms, which I invariably found to be present in smeary liquors; but smear is now a thing of the past, and I will not waste time in referring to it further.

The other kind of fermentation, however, which I shall call the lactic, demands our earnest attention, for no sugar-house is absolutely free from it, although in those that have placed themselves under competent chemical direction it is reduced to a trifling amount, and gives little or no trouble. The lactic fermentation occurs only in weak liquors, especially in those below 5° Baumé; it is most active at a temperature ranging from 38° to 49° (100° to 120° F.), and it is produced most energetically by the oxidising action of animal charcoal. This subject has been minutely described in my paper on "Animal Charcoal," published only a few months since,[*] but I shall briefly summarise the matter. When sugar liquor is run hot into a cistern filled with animal charcoal and drawn off again at a comparatively high temperature, little or no fermentation occurs; but when the process is ended, and the char, impregnated with vegetable albumen and various impurities extracted from the liquor, is washed with water containing free oxygen, the char is soon cooled down to the temperature most favourable to the lactic fermentation, and the washings come away sour and putrid, and more or less loaded with lactate of calcium and other salts, the lime being derived from the calcic carbonate contained in the charcoal besides a distinct quantity of iron. The weaker the washing water, it is generally the more acid, until at last the washings contain more calcic salts than sugar. It is customary to use the weak char washings for dissolving fresh sugar, but this is a most pernicious system as, amongst other evils, it introduces iron into the crushed sugar together with an offensive odour. These evils, as described in my paper on "Charcoal," may be prevented by keeping up the char cisterns to a pretty high temperature and washing with water kept constantly boiling. The char washings also, if not immediately boiled down, should be kept up to near the boiling point by means of steam pipes.

Having thus described the two varieties of sugar concerned in sugar refining, I shall now allude briefly to the

MANUFACTURE OF CANE SUGAR.

A tolerably complete description of the principles and practice of this industry will be found in various books of reference, such as Knapp's "Technology," Muspratt's "Dictionary," or Ure's "Dictionary of Arts," (new edition), and I shall only refer to a few points. The sugar cane contains about 16 per cent of sugar and 70 per cent of water, together with about ·3 per cent of soluble salts, making altogether about 86 per cent of juice, of which three-fourths are expressed in the cane-crushing mill, provided it is a good one, and one-fourth is left in the megass or crushed canes. One would fancy that such a great loss as one-fourth of the whole produce of the growth of the cane would make the planters careful to save any further loss or deterioration of the product, yet until very recently the process of treating the cane juice after expression has been exceedingly crude and wasteful. The juice, at about 10° Baumé, is mixed as soon as possible with a certain amount of lime, called temper lime, and heated in a vessel called the clarifyer. A scum rises to the surface (consisting of vegetable albumen and other matters) and, after settling, the clear liquor is run off to the first of a series of evaporating pans in which, gradually transferred to a pan nearer the source of heat than the last, it is boiled down to such a consistence that on cooling it forms a good crop of crystals. The mixture is afterwards placed in hogsheads or casks perforated with holes into which reeds are inserted, and the mother liquor, called molasses, is allowed to drain away; but the sugar is never fully drained, and consequently loses considerably on the voyage to this country. The process has many other disadvantages: the high temperature of the pans or "teaches" as they are called, especially the last of the series, in which the juice is boiled down to the strength necessary for forming crystals, gives rise to the formation of a large quantity of fruit sugar and of coloured products, the subsequent removal of which, by animal charcoal, adds much to the expense of refining. And, again, in most factories sufficient care is not taken to prevent fermentation, hence acids are formed which, in the boiling down, favour the formation of fruit sugar, which in ordinary West India sugar, such as is used for refining purposes, generally amounts to from 4 to 6 per cent. The use of sulphurous acid, sodic sulphite, and calcic bisulphite, has been attended with most favourable results in our West India colonies, preventing fermentation very completely, and also improving the colour of the product. Of the three forms in which sulphurous acid may be used that of the gas is, I believe, the best, but the bisulphite of calcium is somewhat easier of application, and answers the purpose perfectly well. The use of sulphurous acid is to prevent fermentation in the juice when weak—after it has acquired a tolerably high density there is little tendency to ferment. The employment of various forms of evaporators in which steam is the heating power has also greatly improved the character of our colonial produce; but unfortunately our sliding scale of duties offers, as it were, a premium to planters to produce a dark coloured sugar, for the finer the colour the higher is the duty. The various duties charged upon sugar entering the ports of the United Kingdom are as follows, the various numbers referring to arbitrary standards; formerly the Dutch standards were in use, of which No. 6 is an extremely low sugar—in fact, almost black, and No. 20 is pure white:—

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[*] *Vide* abstract in Chemical News, vol. xvii., p. 249.

Refined sugar		12s.	per cwt.
No. 1.	(above No. 15, D.S.)	11s. 3d.	,,
,, 2.	(11 to 15, D.S.)	10s. 6d.	,,
,, 3.	(9 to 11, D.S.)	9s. 7d.	,,
,, 4.	(below 9 D.S.)	8s.	,,
Molasses		3s. 6d.	,,

The evaporators referred to are all constructed upon the principle of taking up a quantity of the liquor in a hot state and exposing it to the air; in one form of it we have a reel of pipes connected by drums or discs at each end, with steam passing through, and as the reel revolves one-half the pipes are in the liquor and the other half in the air, with a thin coating of the liquor upon them; in another form of the apparatus a series of flat hollow discs, kept filled with steam, are fitted to a hollow axis, by which the discs are revolved constantly, one-half in the liquor, the other half in the air. Vacuum pans are now largely used in the colonies, but the product obtained with them—at least, the first crop of sugar—is more suitable for direct consumption than for refining. In the ordinary mode of boiling down only one crop of sugar is obtained, but when a vacuum pan is used, and the process is otherwise carefully conducted, two crops may be had. Thus in Mauritius there is prepared, first a fine hard-grained sugar largely used in England for domestic purposes (Scotland raw sugar is only used for refining), and next what is called "syrup-Mauritius sugar," used by refiners. The molasses in this case are not very good, at least if I may judge from the rum that is imported from Mauritius. It has been attempted to make refined sugar in the colonies direct from the juice, but without much success. The scarcity of skilled labour, the dearness of fuel, and in many cases the want of a copious supply of pure water, have all operated against the realisation of this scheme, and practically the idea has been abandoned. The next best thing would appear to be to boil down the whole juice in such a manner as not to destroy it, and then bring it to this country to be refined; and this is the principle of Mr. Alfred Fryer's concretor. This is an apparatus which has for its object the boiling down the juice as soon as it is expressed with great rapidity so as to prevent fermentation, and in such a manner as not to affect the colour by too high a temperature. The juice is poured on to one end of a nearly flat iron table with ridges placed across it, so that the liquor travels from side to side about sixty times before it reaches the bottom of the inclined plane, the length of which is about 48 feet and the breadth 6 feet. A furnace is placed at that end of the machine where the liquor enters, and the flame travels down to the lower end, where the waste gases are utilised in heating a current of air which is afterwards passed, first through the inside of a cylinder placed upon its side and revolving so as to keep a fresh portion of juice always exposed to the heated air, the temperature of which is about 350° F., and then in the opposite direction over the surface of the evaporating liquor, the air being impelled by a fan. The flow of juice at the upper end is regulated so that the evaporated liquor escapes at the end at 25° or 30° B., and after passing through the cylinder will form, on cooling, a tolerably hard dry cake, containing only 6 to 8 per cent of water. This product is concrete. It has been said that cane juice contains no fruit sugar, but if this is the case with the canes as they are growing, it certainly does not hold in the case of the expressed juice, for the concrete, according to numerous analyses I have made, contains from 4 to 12 per cent of fruit sugar, averaging at least 7, and the inferior lots are, therefore, unsuitable for refining on the Greenock system of putting out no syrup.[*] Mr. Fryer's process is an admirable and a most valuable one; only I think it is, in the case of bad juice, carried too far. If the juice, when bad in quality, were allowed to leave the apparatus with 15 to 20 per cent of water in it, and the cooled product were drained or put through centrifugal machines, a product would be obtained which would contain a very moderate proportion of uncrystallisable sugar and very suitable for refining, while the molasses would only amount to about 15 or 20 per cent of the total produce. The advantages of the concrete are—great rapidity of production; prevention of the formation of fruit sugar and coloured products; the almost entire absence of loss from drainage during the voyage to this country; the obtaining the entire product of the juice without loss; and the lessening to a large extent of the labour formerly required.

In the East Indies a considerable quantity of sugar is made from a kind of palm tree, and from another tree which yields what is called jaggary sugar; but it is not necessary for me to describe the processes. Maple sugar is made in Canada, but only in small quantities, and the consumption of it is chiefly confined to the locality where it is made.

I cannot, however, avoid referring at some length to the manufacture of sugar from beet-root, an industry of recent origin, brought into existence by what may be called accidental circumstances, but one that has arrived in a marvellously short time to a state of high perfection.

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[*] The imports of concrete from Antigua this year have contained an average of only 4·2 per cent fruit sugar, according to Mr. Fryer, but the produce of some of the other islands has not been so good.

Our refiners have adopted many valuable improvements from their continental neighbours, and although as refiners only they may consider themselves inferior to none in the world, they cannot afford to remain in ignorance of any improvements introduced into the fabrication of beet sugar.

When the beets are brought to the *fabrique* with their heads and tails cut off, they are at once sent up by an elevator to a washing machine, which is a cylinder into which the beets enter at one end and come out sufficiently washed at the other. They are next brought in contact with a rasping machine, consisting of a cylinder about 18 inches in diameter with small teeth upon its circumference, revolving at about 1200 revolutions per minute, by which they are reduced, with extreme rapidity, to a very fine pulp. The pulp, as quickly as it is produced, is placed in small bags, holding probably about 30 lbs. each, and these are subjected, between stout sheet-iron plates, to the action of a screw press, and afterwards to that of another press, where, by hydraulic power, the juice is very thoroughly squeezed out, leaving the pulp almost dry. The juice is passed immediately to a *mont-jus*, in which to every hectolitre of juice is added 10 litres of milk of lime of 25° Baumé (about 1·2 sp. gr., or 40° Twaddell). When full, the mont-jus is closed and steam injected, by which the mixture is sent up to a higher flat, and into a vessel where the first carbonatation is effected. In this vessel the liquor is heated, but not boiled, and carbonic anhydride, made by decomposing limestone by heat, is injected by a pipe placed at the bottom of the vessel and pierced with holes. The passage of the gas occupies about twenty minutes; the liquor is examined from time to time, and when the calcic carbonate formed appears grainy and settles readily, the process is finished. The liquor, at first of a red colour and muddy, is now nearly colourless and pretty clear. The whole contents of the carbonatation vessel are run into a cistern, and the calcic carbonate and impurities carried down with it allowed to settle down, after which the clear liquor is transferred to a mont-jus, in which it is mixed with 1 litre of milk of lime of 25° Baumé to every hectolitre of juice, and this is followed by a second treatment with carbonic acid. The liquor, after settling, is filtered through animal charcoal, after which it passes, at a strength of 3° to 4° Baumé, into the peculiar apparatus used for evaporation, called the triple effet, or triple effect, although the translation does not convey the exact meaning of the original. It is, in fact, a series of three vacuum pans, all connected together; the weak liquor, as it is evaporated in the first, being after a time transferred to the second, and the contents of the second to the third, from which at last it is drawn off at a gravity of 20° to 25° B. The pans are upright cylinders, about 10 feet high and about 4 or 5 feet wide, and the construction is similar to that of an upright multitubular boiler. Steam (sometimes waste steam from a high-pressure engine) is admitted to the first of the three pans, which is boiled at a vacuum of about 7 inches; the steam from this pan (that is, the steam from the sugar liquor) heats the second one, which is boiled at about 14 inches of vacuum, and the steam from this heats the third, which is boiled at as complete a vacuum as can be obtained, say 27 to 28 inches. The saving of fuel effected by the use of this combination, as compared with that of a single vacuum pan, is about a third—that is to say, 2 tons of fuel with this system evaporate as much water as three tons with the ordinary vacuum pan. It is not adapted, however, to the strong liquors of a refinery, or the rapid boiling then required, so that I do not see how we can profit by this experience of our ingenious French neighbours, unless, perhaps, it might be in boiling down char washings.

From the triple effet the evaporated juice is elevated by a mont-jus to a cistern, where it is heated to boiling, then passed through animal charcoal, and lastly boiled down to a grain in a vacuum pan of the usual construction. An almost perfectly white sugar is obtained, and the syrup is boiled over again, and so on three, four, or five times, the product becoming gradually darker in colour and more contaminated with alkaline salts and organic impurities. The last crop of sugar is allowed to stand in cisterns for several weeks, in order to crystallise, as the salts retard considerably the crystallisation of the sugar. The beet sugar that comes to this country for refining purposes is, I believe, the third or fourth crop, and contains from 1½ to 4 per cent of alkaline salts, there being sometimes a very considerable quantity of nitrates present. The syrup drained from the last crop, or beet-root molasses, is a very impure substance. It has a gravity of about 1·4, and, according to my own analyses, contains about 60 per cent cane sugar, about 0·5 per cent fruit sugar, about 3 per cent of extractive and gummy matters, and 13 per cent of salts, chiefly of potassium, the remainder being water. Until a year or two since this molasses, being unfit for food, was fermented, and a coarse kind of spirit made from it, while the residue in the still was boiled down and calcined to obtain salts of potassium, the most valuable of these being the carbonate. But by a most beautiful adaptation of Graham's dialyser, by Dubrunfaut, the salts are to a large extent removed, after which the greater part of the sugar can be crystallised out. The apparatus is called the Osmogene, and consists of about 50 cells, separated by sheets of parchment-paper, laid flat and connected at the edges all round, the space between each pair of sheets being fully half an inch. Each sheet is supported by a cross piece of wood and a net-work of twine. The whole arrangement is about 4 feet long and 3 feet high. By a peculiar arrangement of connection, the syrup admitted from below passes through every second division, while water admitted above also passes through every second space, and at last flows off below at a strength of 1° to 2° B., or, say, 1° to 2½° Twaddell. Owing to the high diffusive power of the salts as compared with that of sugar, the former readily pass through, together with only a comparatively small proportion of the sugar, which may be saved, as before, by fermentation. This will no doubt appear to many too delicate a process for a work on the large scale, but experience has proved that it works well, and that six such machines are sufficient for a *fabrique* working daily 250,000 kilogrammes, or about 250 tons of beets. The same inventor has also another process intended for the same object—that of separating the sugar from the alkaline salts. The sugar is thrown down as a sucrate of barium, by the addition of sulphide of barium, and the precipitate, after being washed, is decomposed by a current of sulphurous acid, which forms the insoluble sulphite of barium, and sets free the sugar. Traces of baryta in the liquor are afterwards got rid of by a current of carbonic acid gas or a little solution of alum. This process, like that of Scoffern for the refining of sugar, introduces a poisonous substance, but there is no difficulty whatever of getting rid of it completely.

Altogether, the perfection of the beet-root sugar manufacture contrasts strongly with that of cane sugar, and the comparison presents in a striking light the effects of Government encouragement to men of science in improving the useful arts compared with the cold and selfish neglect of such men in this country, where all improvements are left to be wrought out by inventors and patentees who have only their own private ends to serve, and who are seldom scientific men deserving the name.

And now, before dismissing the subject of beet sugar, I wish to say a few words about the French sugar duties, and their influence on British refiners. These duties are much higher than the English, being—Nos. 7 to 13, 42 francs for 100 kilogrammes, or something like 17s. per cwt.; Nos. 14 to 19, 44 francs; and No. 20, 45 francs. Now the French have a curious system of valuing sugars, and a very unfair one, as their refiners well know, and in which they greatly rejoice. They calculate that not more than 67 per cent of refined sugar can be made of raw sugar under No. 7, 80 per cent from sugar from 7 to 9, 88 per cent from sugar of 10 to 14, and 94 per cent from sugar from 15 to 18. Now when a refiner takes in a quantity of sugar, he does not pay the duty at once, but is debited with the amount in the Government books, and when he exports refined sugar he gets a document called an *acquit*, or bill of acquital, the effect of which is that, exporting 67 tons of refined, he obtains an acquital for the duty of 100 tons of raw; whereas the fact is he probably makes at least 80 out of the 100 of raw, besides a quantity of syrup, so that he has 13 per cent of sugar and all the syrup duty free. There is thus a premium given to refiners to export their produce, and it comes to this country in the form of loaf sugar in enormous quantities, while it is impossible for our refiners to compete with any chance of success. I trust the attention of Government will be directed to this subject before all our refiners who make loaf sugar are ruined.

Dr. Wallace here intimated that he had only been able to overtake about half of his subject, and hoped on an early occasion to devote an entire evening to the chemistry of sugar refining. An animated discussion followed, chiefly relating to the concrete and to the beetroot industry. A gentleman connected with the sugar trade in Greenock stated that the growth of the sugar beet in this country was about to be commenced under the auspices of Mr. Duncan, sugar refiner in London, and formerly of Greenock.

PHOTOGRAPHY IN CONNECTION WITH THE ABYSSINIAN EXPEDITION.

By H. BADEN PRITCHARD,
(Of the General Photographic Establishment of the War Department.)

The purposes for which photography was used with the army in Abyssinia were very different to those for which it is generally employed by professional followers of the art. Photography in that campaign fulfilled all the duties of a printing-press in the field, and rendered unnecessary, in many ways, the employment of skilled draughtsmen and lithographers. Maps, plans, and sketches of routes were by its means elaborated and put together and afterwards multiplied with unerring exactitude and great rapidity. This was the principal function performed by the art, and for the fulfillment of which the photographic equipment was sent out; the taking of pictorial views and sketches of the country, although forming an important part of the photographer's duties, was a matter of secondary importance, and partook more of a semi-official character.

In moving an army over an enemy's land, especially if that land be an untravelled and unknown one like Abyssinia, it is imperatively necessary for the commander-in-chief to obtain correct information of the nature of the surrounding country, the state of the roads, &c., over which his troops will have to pass. For this purpose *reconnaissances* are frequently pushed forward to the front and on the flanks of the army, to examine and survey the adjacent ground; and staff officers, who had previously received special instruction in their duties, carefully sketch out a plan of the district visited, which they forward, together with such information as may have been collected, to the Quartermaster-General's Department. A scale is of course attached to every plan sent in, but this need not be the same in all maps; for when the latter, after examination and verification, are forwarded to the photographers to be copied, an enlargement or reduction of them is easily made to one uniform scale. The copies are printed upon salted paper and mounted upon linen; and the work is done so rapidly that it frequently happened that thirty prints were produced and distributed within twenty-four hours of the receipt of the original plan. In order that officers might be acquainted with the method of working adopted by the photographic staff, and likewise with its resources, General Simmons, C.B., R.E., prior to the despatch of the equipment, carefully drew up a memorandum relating to it, for the information of all concerned. According to this document it was stated that whenever a plan was forwarded to be reproduced, the first copy might be expected in about two hours, after which copies would succeed each other at the rate of about four per hour of sunlight. To so great an extent was photography used in this connexion during the late American war, that within the period of one month during General Grant's advance to the Rapidan no less than 1200 maps of this kind were circulated. Thus it will be seen that at the present day photography plays a most important *rôle* in aiding the movements of troops, often furnishing the several commanding officers of the different branches of the army with details of a *reconnaissance* taken only the day before.

Seeing the importance of the services to be rendered and amount of work to be performed, it was necessary to furnish a very ample photographic equipment; and the collection of instruments and materials sent out was therefore a bulky affair. The selection and arrangement of the stores and apparatus was entrusted to Captain Stotherd, R.E., and Lieut. Anderson, R.E., the Instructor and Assistant Instructor in Photography at the Royal Engineer Establishment in Chatham—gentlemen, therefore, posessing considerable experience in the art, and well acquainted with the necessaries likely to be required for a campaign; and the general success which attended the working of the equipment was in great part attributable to the excellent manner in which these officers acquitted themselves of their onerous duties.

Two separate outfits were supplied, each contained in eighteen boxes; but only one of these was used and taken forward with the army to Magdala; the reserve outfit remained at Senafé and was returned to England intact. The equipment may at first sight appear far too extensive; but when it is remembered that the nature of the work to be performed involved the employment of a large camera, the supply of other necessaries was of course also requisite of corresponding size and quantity; it must likewise be borne in mind that the duties of the photographers were not confined to taking negatives only, but that the greater part of their labours were devoted to the processes of sensitising, printing, and mounting—operations which had mostly to be conducted within the limits of the dark tent with which they were provided. A large copying table, mounting boards, and material, washing utensils, a portable still, &c., were found to be almost indispensable, and helped to swell the list of incumbrances to a notable extent, not to mention the glass plates for the negatives and paper for the positives, of which sufficient was provided in each equipment for taking 200 large *clichés* and 1700 prints.

On any future expedition of this kind the application of photography will no doubt receive even more extended employment than at present. It would afford the most invaluable information to commanding officers if the mechanical *reconnaissance* sketches were always accompanied by an actual photograph showing the nature of the ground surveyed. If a small stereoscopic view were thus attached to the map drawn to scale, one would immediately be able to understand the true character of the district; all the mountains, ravines, rising ground, declivities, rivers, lakes, &c., would be shown at a glance, and their position at once comprehended. The negatives might easily be taken by the staff officer making the *reconnaissance*, who would be provided with a small camera and a couple of dark slides containing dry sensitive plates.

He would require at the most but five minutes to perform the duty, and would simply need instruction as to the approximate time necessary for the exposure of the plates; on his return he would hand the negatives over to the photographic staff, who would develope and print them. The stereoscopic cameras would also be useful for ordinary manipulation, as the negatives produced are of sufficient size for most purposes and are always capable of being enlarged if necessary.

The *personnel* of the equipment consisted of one chief photographer, Sergeant John Harrold, R.E., and seven assistants, all of whom belonged to the 10th Company Royal Engineers; besides photographers the Company included men skilled as telegraphers, signallers, well-sinkers, &c., all of whom were under the orders of Lieut.-Colonel Pritchard, R.E.

The difficulties of working were sometimes very great, especially near the coast, and the experience gained will, in many cases, be of great value. The dark tent seems to have been the *bête-noire*; although no doubt very suitable for employment in a temperate climate, it proved for Abyssinian service exceedingly hot and close and also very unsteady. Sergeant Harrold suggests that it would be a great improvement to furnish the same with guy ropes, for the purpose of rendering it firmer and more solid. The tent was several times blown down and the covering continually flapping about from the effect of the sand-storms and strong mountain breezes, so that some difficulty was experienced in drying the pictures and in conducting the operations connected with printing. The fine sand blowing about was a most serious annoyance, as it was quite impossible to prevent it from penetrating the boxes, camera, and utensils: even the photographic solutions became contaminated with it, although the tent was kept so close and tight as almost to prevent breathing, the effect of being shut up in a confined space without light or ventilation on the glaring shores of the Red Sea being a sensation more easily conceived than described. For hot climates it would no doubt be better to construct the dark tent with a white or yellow outside covering, which would fail to absorb the heat rays in the same degree as an ordinary black tent. At Annesley Bay and Senafé especially the heat was very intense, and great vigilance was necessary to preserve the collodion of the proper consistence and to avoid the desiccation of the plate when taken from the bath.

The manner in which the collodion and iodising solutions were stoppered was one which the chief photographer found to be very faulty; in some cases as much as half of the solutions had evaporated, and the remainder therefore required judicious doctoring. The best plan to secure these liquids would be to cork and seal up the bottles, a glass stopper being tied round the neck for employment after the vessel has once been opened.

The collodions sent out were of the usual descriptions at present in the market, and, on the whole, answered very well. For hot sunny climates, however, there can be no doubt that a liquid collodion should be selected especially rich in alcohol, and sensitised with salts which exert a liquefying action upon the material, as, for instance, the iodide and bromide of ammonium. It would appear, moreover, that a collodion which is not so very highly sensitive is best suited for employment in the tropics; and if required for landscape purposes, it should contain a goodly proportion of bromide in order to secure as much detail and half-tone as possible. To prepare a material of this kind it would be necessary to diminish the amount of sensitising salts, as the rapidity with which a collodion works is governed mainly by the quantity of these salts contained in it; the proportion of bromide and iodide to be employed might soon be ascertained by a few experiments undertaken in the sunshine, but, according to Dr. Vogel, five equivalents of bromide to one of iodide may be used with good effect, provided an acid bath be employed to prevent the fogging of the negative.

The greater part of the varnish (chloroform and amber) was found unsuitable for use in a hot climate out of doors, as the film did not harden rapidly and was frequently rendered tacky by the heat; this was the more annoying from the circumstance that whenever a negative was taken, copies of the same were required to be printed off immediately. For work of this description Sergeant Harrold prefers to use Newman's Diamond Negative Varnish.

(To be continued).

FOREIGN SCIENCE.

Paris, Dec. 16, 1868.

Crystallisation of Ice.—Oxidation Products of the Carbylamines.—Decomposition of Alkaline and Earthy Sulphides by Solution in much Water.—Posthumous Memoir of M. Pouillet.—Latent Heat of the Volatilisation of Sal Ammoniac.—Physiological Action of Iodides of Methylstrychnium and Ethylstrychnium.

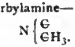
At the meeting of the Academy on October 19th, M. Barthélemy made a communication "On the Crystallisation of Ice, and the Formation of Air-bubbles in the Congealed Mass"; M. Gautier, "On the Oxidation Products of the Carbylamines." M. Palmieri continues his investigations with regard to the eruption of Vesuvius. There was also a note "On the Density of Saline Solutions," by M. de St. Martin.

On the 26th of October the following memoirs were communicated:—"On a Differential Refractor for Polarised Light, by M. Jamin; "Note on a new Volatile and Saccharine Principle found in the Caoutchouc from Gabon," by M. Aimé Girard; "On the Decomposition of Alkaline and Earthy Sulphides by Solution in much Water," by M. Béchamp; "New Researches on Electrophoruses with Revolving Discs," by M. Volpicelli; "Formation of Homologues of Benzol by the Reciprocal Action of more Simple Carbides in the Free State," by M. Berthelot; and "On the Carbonaceous Matter of Meteorites," by the same author.

On the 2nd of November, a memoir found among M. Pouillet's papers was submitted to the Academy. The title is "On the Polar Distance and the Quantity of Fluid in Magnetised Bars: these two elements may be determined for any bar whatever by the simple action exerted upon a compass needle of which neither the polar distance nor the magnetic force is known." A number of other memoirs were presented, those of chemical interest being the following:—"On the Latent Heat of the Volatilisation of Sal Ammoniac," by M. Marignac; "Note on the Composition of Chromiferous Irons," by M. Peligot; "On the Achromatism of Interference Fringes," by M. Jamin; "Researches on the Physiological Action of the Iodides of Methylstrychnium and Ethylstrychnium, by MM. Jolyet and Cahours; "On Acetenylbenzol, a New Hydrocarbon of the Aromatic Series," by M. Glaser; "Chemical and Therapeutic Researches on the Thermal and Sulphuretted Water of Pouzzoles," by M. De Luca; and a note relative to "A Classification of Simple Bodies, founded on the Numerical Value of their Equivalents," by M. Gilles.

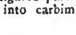
There are few bodies which are oxidised with so much energy as the carbylamines, M. Gautier remarks. The ease with which these bodies are oxidised may be proved by two striking experiments. Firstly, when a layer of methylcarbylamine is placed at the bottom of a sufficiently long tube, and heat applied to the upper part of the tube, at some slight distance from the surface of the liquid, the vapour unites at a certain moment with the oxygen of the air without inflaming; the temperature of the lower portion of the vapour and of the tube rises rapidly, and the liquid disappears in the state of oxidised products. Secondly, upon throwing carefully a small quantity of ethylcarbylamine on dry oxide of silver, the reaction is so energetic that an explosion generally follows.

M. Gautier has already remarked that the carbylamines correspond to the cyanic ethers or carbimides of M. Wurtz, and not to the true cyanates (isocyanates of M. Cloëz). To the methylcarbimide—



$$\mathrm{N}\begin{cases}\text{ЄO}\\ \text{ЄH}_3\end{cases}$$

corresponds methylcarbylamine—



$$\mathrm{N}\begin{cases}\text{Є}\\ \text{ЄH}_3.\end{cases}$$

M. Gautier has investigated particularly the transformation of carbylamines into carbimides, and the proof of the theory. To demonstrate the true constitution of the substances cited as parallels, it was necessary to oxidise the carbylamines to cyanates. After vainly essaying the action of binoxide of lead, which strangely has no effect on the carbylamines, and oxide of silver, which produces too violent reactions, and its carbonate with the same result, M. Gautier succeeded with the oxide of mercury, obtained by calcining the nitrate.

Oxidation of Methylcarbylamine.—When a molecule of dry oxide of mercury is added to a molecule of methylcarbylamine kept cool, and the mixture allowed to gradually heat itself in a bath of water, the temperature being prevented from rising above 45° or 50°, the oxide is reduced, carbonic oxide and a little carbonic acid being evolved; and by cooling with great care the vapours carried off, a small quantity of a liquid may be obtained, which after contact with fresh oxide of mercury and redistillation, boils at 43° to 45°; the vapour of this liquid possesses a pungent odour and irritates the eyes painfully. The analysis of this product, though not obtained in a state of purity, furnished numbers indicating the compound to be cyanate of methyl. Wishing to prove the identity of this cyanate with the cyanate of M. Wurtz, otherwise than by the point of ebullition and the organoleptic properties, M. Gautier endeavoured to transform it into dimethylurea. That methylcarbimide treated with water is converted into dimethylurea with disengagement of carbonic acid, is well known. M. Gautier treated the liquid with water, and after proving the disengagement of carbonic acid, obtained by evaporation a crystallised substance, melting at 95° and possessing all the characters of dimethylic urea. This important point is then proved, that the oxidation of methylcarbylamine furnishes cyanate of methyl, according to the equation—

$$N\left\{\begin{matrix}C\\CH_3\end{matrix}\right. + H_2O = N\left\{\begin{matrix}CO\\CH_2\end{matrix}\right. + H_2$$

At the same time, this is not the product produced in greatest abundance.

Ethylcarbylamine treated with oxide of silver furnishes products from which may be extracted a crystalline body, boiling above 200°, soluble in water and alcohol, and possessing the formula $C_{13}H_{25}N_5O_4$. This complex compound may be conceived as analogous to that obtained by M. Hofmann in combining urea with cyanate of ethyl. Ethylcarbylamine dissolved in four volumes of ether suffers a rather less complex reaction. As the principal product, a body is obtained soluble in water, ether, and alcohol. This substance, which is crystallised, melts at 112°, and yields upon analysis numbers agreeing with the formula $C_9N_4H_{22}O_2$.

M. Béchamp's note "On the Decomposition of Alkaline and Earthy Sulphides by Solution in a Large Bulk of Water," is sufficiently short to be given almost *in extenso* here. In May, 1866, M. Béchamp presented a note to the Academy, "On the Employment of Nitroferricyanide of Sodium for Demonstrating the Presence or Absence of Alkaline Sulphides." He endeavoured to demonstrate there, that water exerts in the mass, a decomposing action on all the alkaline and earthy sulphides, in such a way that, at a certain point, the free sulphuretted hydrogen and the hydrated oxide of the metal may be present in the solution at the same time. Nitroferricyanide of potassium served to determine this limit. But by the action of a current of sulphuretted hydrogen, or that of the vacuum, which removes the sulphuretted hydrogen, that the state of things described takes place, may be verified. Sulphide of magnesium has especially served to place this in evidence; this compound cannot exist in any other manner in the water without decomposing into sulphydrate of sulphide and hydrated magnesia, and the solution of sulphydrate, exposed in the vacuum, or to the action of a current of pure hydrogen, very rapidly deposits hydrated magnesia, losing all its sulphur in the state of hydrosulphuric acid. M. Béchamp has applied the results of this work to sulphurous mineral waters. He finds that sulphide of calcium and likewise sulphide of sodium are wrongly attributed to certain sulphurous waters: The waters of the *Amélie-les-Bains* and of the *Eaux-Bonness* do not really contain sulphide, but free sulphuretted hydrogen, together with the hydrated alkali in the free state also.

Chloride of ammonium, volatilised by heat, occupies a volume double that required by a theory which has obtained numerous supporters. M. Marignac says that if this volatilisation be due to a simple change of state, an amount of heat comparable to that necessary to produce the same physical modification in other compound bodies should only be required. If accompanied, on the other hand, with a more or less complete chemical decomposition, it ought to require a much more considerable amount of heat, little different from that resulting from the chemical combination of ammonia gas and hydrochloric acid. These considerations led M. Marignac to attempt a determination of the latent heat of the volatilisation of sal-ammoniac. He considers the result to be only a crude approximation, owing to numerous difficulties in experimentation, though sufficient for the purpose in view.

The method employed was the measurement of the amount of heat consumed in volatilising the salt (in the air), and comparison with that consumed in volatilising water under the same circumstances; and the apparatus consisted of a massive cylinder of iron, with three openings symmetrically disposed round the axis; one to receive an air-thermometer, the other two the substance to be volatilised. The iron cylinder, previously heated to redness, is supported in a case, the sides of which are as bad conductors as possible, but in such a way, that its upper face remains exposed to the air. At the moment when the cylinder attains a certain temperature—500° for instance—the substance to be volatilised, enclosed in small glass or silver tubes, is introduced. The tubes are withdrawn when the thermometer marks 420°; the loss of weight gives the amount volatilised. A study of the cooling of the apparatus, by numerous experiments, equally when empty and when containing substances in the interior, when a portion of the heat is employed in volatilising water or any other volatile substance, enables a calculation, doubtless not quite exact, to be made of the amount of heat consumed internally in each case. Operating thus with sal-ammoniac, M. Marignac found the latent heat of the volatilisation of sal-ammoniac, for 1 gramme, 706 calories, with a greater probability that its real value is comprised between 617 and 818. The largeness of this number, compared to that which expresses the latent heats of volatilisation for those compounds in which the determination has been made, and, on the other hand, its concordance with that which expresses the heat from combination of ammonia gas and hydrochloric acid, induced M. Marignac to think that sal-ammoniac is actually in great part decomposed, when converted into vapour. According to MM. Favre and Silbermann, this heat of combination is 743·5 calories at the ordinary temperature; it would be 715 for the temperature of 350°.

To corroborate his conclusion, and to prove that the elevation of these results was not due simply to the imperfection of the method employed, M. Marignac has determined by the same means, the latent of several other substances approaching sal-ammoniac in physical properties, and with sufficient success.

Glasgow Philosophical Society (Chemical Section).—A meeting was held in the Society's Rooms, Andersonian Buildings, on Monday evening, the 7th inst., Alexander Whitelaw, Esq., Vice-President, in the chair. Six new members were admitted. Dr. Wallace, F.R.S.E., F.C.S., read a paper "On the Chemistry of Sugar Manufacture and Sugar Refining," which we give in full, and which, on account of the long and well-known connection of the author with that branch of industry, will, we have no doubt, be well received by our readers.

CORRESPONDENCE.

THE NEW POISONS ACT.

To the Editor of the Chemical News.

Sir,—If you can give me any information relative to the working of the new "Poisons Act," I shall feel much obliged.

I supply chemists and manufacturers at Glasgow with chemicals for analytical purposes (in connection with my chemical apparatus business), and cannot obtain any information here as to whether it is requisite that I should be "registered" under this Act? If so, can you inform me *what* registrar (*i.e.*, registrar of *what*) to apply to, as every one to whom I have applied here assures me that it does not come under his notice at all.—I am, &c.,

John Spencer.

[The Act does not interfere with the business of wholesale dealers in supplying poisons in the ordinary course of wholesale dealing; but from and after the 31st day of December, 1868, it will be unlawful to sell or keep open shop for retailing, dispensing, or compounding poisons without being registered. Our correspondent must write to the Registrar, Elias Bremridge, 17, Bloomsbury Square, W.C.—Ed. *C. N.*]

WHITE PRECIPITATE.

To the Editor of the Chemical News.

Sir,—At the last meeting of the Chemical Society, as reported in your issue of December 11th, the following equation was suggested as the simplest explanation of the formation of "white precipitate":—

$$HgCl_2 + NH_4NH_2 = HgNH_2Cl + NH_4Cl.$$

For teachers, if not for students, the explanation certainly has the merit of simplicity; but, unfortunately, it is not true. When ammonia-gas reacts with corrosive sublimate, a compound entirely different to "white precipitate" results; and the compound does not simply yield "white precipitate" by the subsequent action of water—good evidence, by the way, that solution of ammonia is not merely ammonia-gas dissolved in water. The following equation is the one given to my own students:—

$$HgCl_2 + 2NH_4HO = NH_2Hg''Cl + NH_4Cl + 2H_2O.$$

To regard ammonia-gas as amide of ammonium may sometimes be useful in research; but most students would be, in my opinion, only thrown into confusion if told that NH_4NH_2 means the same as NH_3.—I am, &c.,

John Attfield.

THE SCIENCE AND ART DEPARTMENT.

To the Editor of the Chemical News.

Sir,—I once before addressed you a letter on the anomalies existing at South Kensington with respect to the examinations for teachers and students. I have now to beg you will permit me to say a few words on a subject, which, though of far less importance, should not be passed over without notice.

My complaint this time has reference to the certificates issued by the Science and Art Department to those candidates who were unable to claim books or instruments for their success in the May examinations. I am perfectly well aware that it is the standard of an examination that gives the value to a certificate, and that intrinsic worth is not to be considered; but I presume it will be acknowledged that a certificate should be authenticated by some signatures. Now, the one to which I allude has no signatures; it is merely a small piece of card, on which is stated the bare fact that the holder passed in a certain subject, in a certain class, and the whole thing is printed and turned out in such a mean and contemptible style that it is scarcely fit for distribution in an infant Sunday-school. I think it will be highly encouraging to those who believe that this country is progressing in Art to know, that last year the certificate, though poor enough, was of a somewhat better description—there was an attempt at artistic device, and there were two signatures; but as the economical schemes at South Kensington are very Molochs, to which students of science are mercilessly sacrificed, even that pitiful dole of dignity has been taken from us, and now the certificate is not worth the trouble of the examination.

When it is considered that those to whom these certificates are given, save the Department much expense, by being unable to claim books, I think it will be owned that they are entitled to receive something which would be of use to them when applying for a situation, or on any other emergency of a like nature. It would be simply absurd to exhibit, on such an occasion, the wretched caricature I have above described. Are there no art students attached to the Museum, who would design a certificate of respectable appearance, for us economy-ridden, but long-suffering, science students? I think there are, and doubtless the offer of a small premium would induce a competition which would result in a production more worthy of a Department that professes to devote a considerable amount of its energies to the cultivation of artistic taste.—I am, &c.,

J. N. F.

Nov. 30, 1868.

CHEMISTRY IN THE EXAMINATIONS OF THE DEPARTMENT OF SCIENCE AND ART.

To the Editor of the Chemical News.

Sir,—The letter of "A Teacher" in your last number, on the introduction into the "new" syllabus of the term "hydroxyl," deserves commendation. His remarks will equally apply to the introduction of the "graphic" notation into the syllabus, since the latter is as much a specialty of the examiner as the former.

But the differences between the "old" and the "new" syllabus are extensive, the latter being divided into no less than six "courses." I do not complain of this division, since it may result in a far more perfect acquaintance with the vast field of chemical science; but why have not the commissioners vouchsafed, for the information of the teachers—for whom, chiefly, the syllabus is useful—some idea of the value attached to passing the several stages. For, manifestly, if "payment upon results" is made progressive, as are the "courses," and the highest payment be no higher than under the "old" direction, then poorly indeed will come off many teachers who have classes of *bonâ fide* "working men," whose desire and willingness to learn is much in excess of their capacity—indeed, of many of them it may be said, literally, "Their brains are grown rusty." If a low scale of payment result from success in the primary courses, then all inducements for teaching classes of working men are gone. I know some will talk about "benevolence," &c., but if an educated man spends time, money, and thought, to improve those who cannot of themselves remunerate him adequately, then it is the duty of the Department above-mentioned to let all teachers feel that its support is a reality, and not a doubtful speculation. —I am, &c.,

Another Teacher.

To the Editor of the Chemical News.

Sir,—In your last number, "A Teacher" complains that the syllabus of subjects in which science classes are examined by the Science and Art Department contains, in the first, or elementary division of chemistry, "The Preparation and Properties of Hydroxyl." Referring to the whole body of teachers of chemistry, he says, that of every ten, not more than one has ever heard of "hydroxyl;" and of the remaining nine, only one is likely to obtain any information respecting it "from the ordinary manuals."

"A Teacher" is at liberty to speak for himself, but he has no right whatever to bring such a sweeping charge of what he is pleased to term "ignorance" against nine-tenths of his fellow teachers.

I do not for one moment believe that such a large proportion are so apathetic as to content themselves with, year after year, reading the same books, and not make themselves acquainted with the views of our leading chemists. On the contrary, I believe that the majority of my fellow-teachers of chemistry are earnest in their work, and desire to keep pace with the rapid march of the science.

Dr. Frankland's views have now been some years before the world: they are no longer peculiar to himself, but are shared in by other chemists of note; and so far from its being the fact that, as your correspondent asserts, "the ordinary manuals ignore 'hydroxyl' altogether," he will find the name, and some account of it, in at least three books which many, if not the majority of teachers, are likely to have by them—viz., Frankland's "Lecture Notes," Kay-Shuttleworth's "First Principles of Modern Chemistry," and the last edition of the manual of manuals—Fownes.—I am, &c.,

WOOLWICH.

December 16, 1868.

To the Editor of the Chemical News.

SIR,—In a very sensible letter in your last issue, "A Teacher" complains of some of the questions which the examiners put to the candidates for the Science and Art certificate. Allow me to make a similiar complaint with regard to the examinations in chemistry held yearly by the University of Oxford, and at which the abilities of boys of from twelve to sixteen years of age are to be tested. These local examinations are, in my opinion, calculated greatly to improve the tone of the private middle-class schools of this country; and it is a pity that in some subjects—chemistry among others—the boys are actually deterred from competing for the certificate.

Anyone who has had experience in teaching chemistry knows how difficult our science is, both to learn and to teach, and anyone who has had to prepare pupils for those local examinations, must have felt discouraged in seeing what kind of questions the examiner selects from year to year. That the majority of those questions are much too difficult to be answered by boys of the age above mentioned, is a fact of which you may convince yourself by looking at them; but why the examiner should make use of such terms as hydrogen sulphate, hydrogen sulphide, carbon dioxide, stannous chloride, and the like, is a fact which I, for one, cannot well understand.

Are boys twelve years old expected to have read the higher chemistry text-books; and among the cheap works which are within the reach of a school-boy, is there any one that gives those new names? As to myself, I do not object to them in the least; but how can a child remember that which he does not see in print, and assimilate in his young mind two or three different names for one substance?

Another ground for complaint is, I believe, the practical examination which the candidates must undergo. They are given half a dozen substances, either single or mixed, and are required to find out what those substances are. Testing is certainly a good exercise for young students; but does the Oxford examiner ignore that very little time is allotted in private schools for the study of chemistry, and that no facilities are given for testing classes; and does he also forget that some expense must be incurred by the candidates in providing themselves with the necessary apparatus and reagents? Moreover, would it not be far more conducive to the study of chemistry by our middle classes to give simple and easy questions of a thoroughly practical character, and chiefly referring to natural phenomena, than to give abstruse questions, which, by the way, might be worded in a clearer and more intelligible manner?

Dr. Debus and Professor Williamson, at the London Matriculation Pass Examination for 1867, gave questions, the simplicity and usefulness of which cannot be too much praised, and the result is, that young men intending to graduate at the London University learn chemistry with pleasure, seeing that that science will not prevent their passing their first examination.

But what is the result of the Oxford local examinations, as far, at least, as chemistry is concerned? Scarcely any candidate presents himself, every one being deterred from doing so by the difficulties which stand in the way; and thus we find that chemistry is as yet, among the majority of the middle classes, a science which is looked upon with mingled feelings of respect and dread.

Science teachers must deplore this state of things. They know by experience that many schoolmasters regard chemistry as an ornamental and useless acquirement, and as a science that cannot be fruitfully taught to young boys. The list of questions which they see yearly proposed to their pupils actually frightens them; and as, also, the boys have to incur a rather heavy expense to be able to present themselves at the practical examination, objections are raised which have for their final result an indefinite postponement of chemical studies in the school.

The publication of this letter, if you deem it fit for your columns, would perhaps induce science teachers to express their opinion on the subject, and I am greatly mistaken if the majority of them do not concur with me in thinking that much good might be done by reforming those hitherto useless Oxford local examinations in chemistry.—I am, &c.,

V. T.

MISCELLANEOUS.

The Royal Polytechnic.—The most interesting scientific entertainment now being given at this institution is Professor Pepper's lecture on a machine-made watch, in which he reviews the history of watches from 1520, when they were first made, to the present time. Through the enterprise of Mr. Streeter, of Conduit Street, in introducing machinery in the manufacture of jewellery and watches, there is an immense saving of labour, and consequently a great diminution in price; and watches are now manufactured with much greater rapidity, and are more accurately finished, which results in excellent time-keeping and greater durability. The lecture is illustrated by the several parts of a watch and the various kinds of watches being exhibited on the screen. Professor Pepper has often shown his ability to render scientific subjects not only intelligible, but very interesting to the general public; but never to a greater degree than in explaining the mechanism of a watch, and the process of manufacturing even the most delicate parts by machinery. While the views are being shown, Herr Schalkenbach enlivens the proceedings by performing on the electric organ, a description of which is previously given by Professor Pepper. The building has been re-painted and decorated; and we have no doubt that the various entertainments will continue to be as numerously attended as on the first evening of Professor Pepper's new lecture.

Action of Water on Lead.—Professor Parkes, F.R.S., of Netley, calls attention to the fact that it has always been seen that the action or non-action of water on lead could not be entirely accounted for by the usual statements on the subject, aud lately Dr. Frankland has made a curious observation, which may throw light on the subject. He found that water which acted on lead lost this power after passing through a filter of animal charcoal. He discovered this to be owing to a minute quantity of phosphate of lime passing into the water from the charcoal; on comparing two natural waters, that of the river Kent, which, acts violently on lead, and that of the river Vyrnwy, which, though very soft, has no action on lead, he found that the latter water contained an appreciable amount of phosphate of lime, while none could be detected in the Kent water. This observation may probably explain much of the discrepancy of evidence in respect of the action of soft water on lead.—*Journal of the Society of Arts.*

The Photographs of the late Eclipse taken in India.—S. Anderson, Lieut. Royal Engineers, Assistant Instructor in Photography at the Royal Engineer Establishment, Chatham, writes to the editor of the *Photographic News* as follows:—

"With reference to an article that appeared in your impression of 23rd ultimo, entitled "Failure of Photographing the Eclipse in India," in which you have unjustly expressed an opinion that the photographers of the Royal Engineers detailed for that expedition were not "experienced" in the art of photography, I beg to inform you that Sergeant Phillips, R.E., the senior photographer, has been employed in Palestine on two expeditions under the auspices of the Palestine Exploration Committee, and that his name is well known in connection with the photographs published by that Society. He had, therefore, great experience of photographing in a hot climate, but, in common with other photographers, he had not had much experience in photographing eclipses, especially in cloudy weather. I may add that Major Tennant has expressed an opinion that his six negatives are equal in scientific interest to any that have been obtained in Spain, and he has valued them at £150 each. The following extract from the *India Gazette* speaks for itself:—'The services of Sergeant Phillips, and Sappers Talbot and Conway, of the Royal Engineers, have been great. They have had a good deal of hard and harassing work in making everything ready. Sergeant Phillips, in particular, has been most useful, and I have much of the success of all preparations to thank him for. The partial failure of the plate observations has been from causes beyond these mens' control, and I would respectfully solicit that His Excellency in Council would be pleased to grant a month's donation of pay to each.—(Signed) J. F. Tennant, Major R.E. As recommended by you, His Excellency in Council sanctions the grant of a donation of one month's pay to Sergeant Phillips, and Sappers Talbot and Conway, of the Royal Engineers.' In conlusion, I may be permitted to add that even if this 'comparative failure' had been the fault of the men, this would not have been logical ground for hinting that the Royal Engineer photographers are 'not familiar with photographic operations.' Lord Napier, in his despatches, repeatedly mentioned the success obtained and good service rendered by the Royal Engineer photographers under most trying circumstances in Abyssinia. In that expedition photography was the field printing press. Staff officers' reconnaisance sketches brought in during an afternoon were at once photographed, and reduced to a uniform scale during the operation, in order that different sketches, if they overlapped, might be subsequently joined together. The sensitised paper was prepared during the night, and impressions struck off in the morning. The prints were finally mounted on linen, and distributed throughout the force. This was the principal work of the photographers, who had also to take care of the mules, carry their arms, and march as other soldiers. In addition to the large collection of negatives of plans, they have brought home a most valuable collection of about eighty negatives of general views, prints from which will be exhibited before the Photographic Society this month. Sergeant Harrold, R.E., the senior photoprapher, shortly before taking the interesting views of Magdala, was detailed as one of the storming party, and for his conspicuous gallantry at the assault of Magdala has obtained a medal for distinguished conduct in the field."

The following remarks are appended by the editor of the *Photographic News*:—

"We are glad to learn that the photographic operations in connection with the recent eclipse observations in India were more successful than the first report indicated. Our correspondent must remember, however, that our remarks were based upon the statements of Major Tennant himself, who described the whole of the plates as 'covered with spots,' and as 'showing but faint traces of the corona;' and he attributed this to the 'concentration of the nitrate of silver solution' by heat. Now this is a condition of things in no wise attributable to the eclipse. It could only have arisen from want of care or want of knowledge, and it is fair to assume that it was to lack of experience, and not any more culpable cause, that such a result was due. If we do the Engineers in whose care the photographic operations were placed any injustice, we regret it, and can only point to Major Tennant's report, and the contrast furnished by the results of the German expedition, in justification of our remarks. Our correspondent mistakes us in fancying that we imply that skilled photographers are not to be found amongst the Engineers. We have before spoken highly of the skill and success of Sergeant Harrold in Abyssinia, and we have had reason to believe that it was owing to the absence of the most accomplished Engineer photographers in Abyssinia that less able men were at the service of Major Tennant's expedition. In our allusion to the Engineers we merely put a hypothetical case, saying *if* the men told off were were not familiar with photography, &c., &c. It is much more pleasant to us to believe that this expodition was in some degree successful than that it was a complete failure."

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3309. W. H. Liddell, Edinburgh, "Improvements in treating all kinds of pig skins in the processes of preparation, tanning, currying, enamelling, and japanning, and in utilising the products."—Petition recorded October 29, 1868.

3352. M. Sautter, Rue de la Chaussée d'Autin, Paris, "Improvements in preparing and preserving vegetable and animal substances."—A communication from W. O. Giles, New York, U.S.A.—November 4, 1868.

3378. W. Irmer, Clerkenwell, Middlesex, "A new, or improved, corn-flour jelly."—November 6, 1868.

3400. P. E. De Wissocq, Rue Richepause, Paris, "Improvements in treating lead ores."—November 9, 1868.

3503. C. E. Brooman, Fleet Street, London, "An improved liquid or composition for oiling or greasing wool and other textile materials."—A communication from H. de la Shibaudiere, Paris.

3506. A. McDougall, Manchester, "Improvements in the manufacture of phosphatic manures and sulphate of ammonia."—November 18, 1868.

3515. C. D. Abel, Southampton Buildings, Chancery Lane, "Improvements in the manufacture of phosphorus and amorphous phosphorus, and in furnaces and apparatus employed for that purpose."—A communication from C. Brison, Chalons sur Saône, France.

3516. H. Carrigg, Manchester, "Improvements in the manufacture of tribasic phosphate of lime, and the application thereof to certain useful purposes."—November 19, 1868.

3541. C. E. Brooman, Fleet Street, London, "Improvements in the manufacture of gas for lighting and heating, and in apparatus employed therein."—A communication from J. F. Lafrogne, Bonlevart de Strasbourg, Paris."—November 21, 1868.

3565. C. D. Abel, Southampton Buildings, Chancery Lane, "Improvements in converting cast-iron into wrought-iron, and in uniting oxides, fluxes, and other substances with molten cast-iron."—A communication from T. S. Blair, Pittsburg, Penn., U.S.A., A. Gozman, New York, U.S.A., F. Ellerarhausen, Ellershause, Nova Scotia, and A. E. Stayner, Nova Scotia.—November 23, 1868.

3569. C. W. Siemens, Great George Street, Westminster, "Improvements in the manufacture of iron and steel, and in furnaces and apparatus connected therewith, part of which improvements are also applicable to the calcining, reducing. and burning of ores and granular substances generally."—November 24, 1868.

NOTICES TO PROCEED.

2293. T. Gibbs, Jarrow-on-Tyne, Durham, "Improvements in the treatment of metallic ores and compounds."

2294. G. Martin, Toadsmoor Rock Mills, near Stroud, Gloucestershire, "Improvements in the manufacture of extract wool, and in the process and apparatus employed in destroying the vegetable material in mixed fabrics, which apparatus is applicable to other purposes."—Petitions recorded July 22, 1868.

2588. F. Braby, Camberwell, Surrey, "Improvements in treating and utilising waste sulphate of iron solution, arising from the cleansing of iron surfaces in the manufacture of tin plates."

2589. A. Clark, Chancery Lane, "An improved compound for tanning leather."—A communication from L. H. Dennis, and O. R. Brown, Stafford Springs, Conn., U.S.A.—August 19, 1868.

3167. R. Pearce, Swansea, Glamorganshire, "Improvements in the separation of copper and other metals from silver and gold, the same being applicable to other metallurgical operations."—October 16, 1868.

3376. W. Baker, Wigan, Lancashire, "Certain improvements in furnaces and fire bars."—November 6, 1868.

NOTES AND QUERIES.

Aluminate of Soda.—Can any of your readers inform me where the aluminate of soda, manufactured from bauxite, is to be had?—R.C.M.

Writing on Gold.—Can you kindly give me "a wrinkle" as to the following matter:—I have a couple of old family minatures set in gold and with gold backs. I want the names of the imprints to be permanently fixed to each. Now the cases or backs are of such thin gold as not to admit of ordinary engraving, as such would weaken the gold considerably. Is there any chemical agent with which I could write the names on the gold, and which would be indelible?—Mubrankin.

The Norwegian Cooking Apparatus.—Dr. Letheby by a Swiss cooking apparatus must, I think, mean the Norwegian box. I found it of great use in yachting. A large box retains the heat sufficiently to give a crew on boat service away from the ship a really hot meal any time during the whole of a long summer's day—no small matter in wet cold weather. Ten minutes fast boiling is sufficient for a large leg of mutton, provided the men do not open the box and let cold air in.—Per Mare per Terram.

MEETINGS FOR THE WEEK.

Monday.—Medical, 8.
— London Institution, 8. Mr. G. F. Rodwell on "Heat as a Science of Kinetics."
Wednesday.—Society of Arts, 8. Mr. H. Bryceson "On the Electric Organ."
— Geological, 8. G. T. Clark, "On the Basalt-dykes of the Mainland of India." Professor W. King and Dr. T. H. Rowney, "On the so-called 'Eozoonal' Rock." T. W. Kingsmill, "Notes on the Geology of China." Dr. Sutherland, "On the Auriferous Rocks of South-Western Africa," with a note by Sir R. I. Murchison, Bart.

TO CORRESPONDENTS.

C. J. Woodward.—Our correspondent's valuable communication shall be inserted as soon as the illustration is engraved.

A. Gray.—An improvement on the method of rapid filtration, with illustrations, will appear in an early number of the Chemical News.

Oleographs.—We have received from Dr. Moffat a book of oleographs. Our correspondent's paper arrived too late for insertion this week. The process is capable of great extension, and will be valuable to paper-stainers and paper-hanging manufacturers. The method of proceeding is to obtain a pattern on water, note the time, lay on the paper glazed side downwards for an instant, take out, draw through plate of ink, remove, and wash with water.

Communications have been received from H. C. James; W. Hankey; F. Walsh; T. Hill; Dr. R. Angus Smith, F.R.S.; Dr. E. Fleischer (with enclosure); J. H. Pepper (with enclosure); Professor Kerl; A. Gray; J. Spiller; C. Mène (with enclosure); Dr. R. C. Moffat (with enclosure); C. J. Woodward; V. de Ternant; H. B. Pritchard; J. C. Davis; C. Tomlinson, F.R.S.; D. Forbes, F.R.S; Magnesium Metal Co.; C. Crump (with enclosure); Dr. Otto Richter (with enclosure); C. J. Rutter; D. Thom (with enclosure); and S Hall (with enclosure).

BOOKS RECEIVED

Mémoire sur la Composition Chimique Des Monnaies Neerlandaises et sur la Volatilisation De l'Argent, par A. D. Van Rremsdyk.

Revue Hebdomaire De Chemie Scientifique et Industrielle, Publiée Sous la Direction de M. Ch. Mène.

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THE CHEMICAL NEWS.

Vol. XVIII. No. 473.

OLEOGRAPHY:

Being a Process for the Utilisation of Tomlinson's Cohesion Figures.

By Dr. R. CARTER MOFFAT,
Lecturer on Chemistry, Glasgow.

As there are some individuals in the world who calculate a man's worth by considerations connected with his grandfather, so there are certain others who calculate the importance of a truth by the date of its history. This reasoning may refer to great truths in our every-day life, but certainly it cannot apply to great facts in chemical science. Discoveries, however new, are welcomed by scientific men with delight. Adding to their store of useful knowledge they go on and on, benefiting their chosen science, and freely giving to those around them interested in the practical application of their discoveries, their results of lengthened and laborious research.

Chemists are aware that most kinds of oil when poured on water spread over its surface, and sooner or later break into variegated patterns, some of which are of great beauty. When we make a few experiments in this direction attention is attracted to the regularity of the forms assumed, and further, that almost all the common oils give different models of patchwork according to the length of time that the oils are exposed. Experiments conducted in my laboratory show that from the construction of the oil film we can with considerable certainty determine the kind of oil examined, and also its genuineness. A drop of pure sperm oil let fall on a basin or plate full of water quickly becomes an enlarged circular film of several inches diameter, breaking up near the edges into small round holes. This takes place in about sixty seconds in the case of pure sperm. The centre of the patch is at the same time filled with little holes somewhat smaller than those at the edges. At two minutes all the little openings are considerably expanded, and they continue to extend until after a lapse of thirty minutes or so, when the oil is broken up and detached. There is value attached to this simple test. Green rape oil breaks up slowly, more so than sperm, but after sixty seconds its pattern is different, the circles being large and beautifully defined. Purified rape oil becomes much larger in the pattern circles than green rape in the same time. Lucca olive gives in one minute a large representation, in two minutes an extraordinary development, and in three minutes a very large likeness.

Green olive, on the other hand, gives but a small pattern in one minute, and conducts itself quite at variance with Lucca olive. Again, seal and castor oil give forms which are very small compared with many oils. In making these observations it is necessary to attend to the size of the drop of oil, the height it falls, the force with which it does so, the perfect purity of the cold water, and the stillness of the water at the time. To make the experiment, proceed as follows:—From a small dry burette drawn out to a fine point filled up to a certain mark with the oil, cautiously let fall a single drop at four inches height upon the centre of the water contained in a common soup plate or glass basin. We shall assume that Lucca olive is taken. The drop should at once spread about four inches on the water circularly. If it does not do so at once then the plate or the water is not clean and the water is to be poured out, the plate well washed with water, and again filled. All rubbing with towels is to be avoided. At thirty seconds, the appearance of the representation is very lovely, having all the similitude of crochet-work. To give definitions of its many figures I would need to have Roget's Thesaurus of English Words and Phrases past me. It is needless at present to enumerate the diversity of these oil films at different periods of time. Tomlinson has enriched science by his masterly descriptions of them. He has done more in this department than any man. To him is due many discoveries in experimental philosophy—facts of the greatest value and importance. It is to him that I would ascribe my recent discovery of the utilisation of the cohesion figures of oil on water. Had it not been from a knowledge of the facts connected with his researches in this beautiful and interesting department of science, then in all probability the oil figures would have remained what they are, beautiful to look at but transient in the extreme. The eye becomes tutored and experienced to these forms, so that it can readily determine the kind of oil under examination. I do not aver this to be the fact in all cases. In very many instances it is so. Indeed, in all that have come under my notice this is the conclusion arrived at. Perfect concordance of results is, I am almost certain, to be obtained when the size of the drop of oil and all other points are rigidly attended to. A slight tremor or shaking of the water is detrimental to a perfect pattern. I have noticed that even a person coughing near the oil film deranges its conformation.

Those who have watched these exquisite shapes have often wished to secure them on paper as a kind of photograph,—to have them brought before the eye palpable and fixed, to be seen at once a reality, a permanent image. Many have tried to do so. For long I had attempted to do the same. In many things apparently difficult yet simple we are apt to think them insurmountable. It is in their very simplicity, however, that we fail to grasp the solution of the problem. The oil patterns uninjured can as readily be transferred from the surface of water, and permanently fixed to be placed in our albums, as we can pour water from one vessel to another. No matter what colours we desire, we can obtain them of any hue we please. They rival the most beautiful photographs. The faintest tracery is brought out with the most perfect fidelity. Two well-known photographers of this city, to whom I showed them this week, declared they were excellent photographs; and yet not a trace of the chemicals photographers use was employed. The process can be described in three lines:—obtain the oil pattern, note the time, lay a piece of glazed surface paper on the pattern for an instant, take it off, place on the surface of a plate of ink for a moment, remove and wash off the excess of ink with water and your pattern is there as it was on the water. You now have an exquisite representation in black, as fine as any photograph. A scarlet is obtained by employing a solution of cochineal or any of the scarlet coal tar colours. We have them in orange, red, scarlet, black, blue, and other tints. A good result is got by first passing the paper containing the pattern of oil through ink and then through cochineal. The principle of the matter is this. The paper absorbs the oil at the several parts to the exclusion of the water. The ink colours the water parts but at the same time tints the oil parts very faintly, which gives it the appearance of relievo. Any kind of paper almost will do. Tissue, green, glazed, white, &c., give pretty good results. The paper I employ, which I find to take up the most delicate parts, is what is known as white surface paper (glazed on one side only). We get it cut in circular pieces of about four inches in diameter. The pattern obtained is of this diameter. A larger pattern could readily be obtained by using a larger drop of oil and a larger size of paper. Mr. Lundy, of Leith, at the inaugural lecture of a course of lectures delivered there last Thursday, exhibited several books of patterns of different oils I sent him. Professor Woodward, of Birmingham, wrote me for some of these fixed representations, but as I did not receive his letter until the very day of the conversazione at Birmingham (owing to the note having been delayed), I was extremely sorry I could not send them in time. There are many applications that this method can be put to. We have been able to take perfect fac-similes of fern leaves by coating them with oil, placing them on the glazed paper, pressing them against the paper, obtaining a perfect likeness of the fern, and showing it in relief by drawing the paper through ink, or cochineal, or other colour. In printing with oiled types on the paper and colouring afterwards, we have also been able to get beautiful results. I think that paper-stainers and paperhanging manufacturers might be greatly benefited by paying attention to our method.

I confidently hope to be able to transfer the patterns even to cloth, to stone, &c.

Scientific chemists are, of course, only interested in this process so far as a test for the purity of oils. I have made many hundreds of experiments with the process, and in a large number of instances have got results with mixtures of oils differing very materially from those with genuine oils. Many more experiments are needed to confirm this, and in a work on the detection of oils, on which I am at present engaged, having added a large number of reliable tests, this will be very fully gone into.

I hope to be able very shortly to place before the readers of the Chemical News further observations on this process of Oleography, as I have termed it. The patterns I call oleographs, as the oleograph of sperm oil, &c.

In concluding the article on this subject, I regret that time has not permitted me to give more results as to the weight of the drop of oil, the temperature of the water—which, by the way, is of no moment if between 40° F. and 60° F.—and many other points. My practical classes here number between seventy and eighty pupils, besides almost daily lectures, and the amount of time for research left me precludes anything like that amount of work being done even were it summer. To make a discovery of this kind at the present season necessitates up in the morning early and retiring to rest at the small hours of morning.

I beg to acknowledge with many thanks the invaluable assistance and hearty co-operation of my chief assistant, Mr. Frantz H. Allen, and Mr. Nicol Brown, a student in the laboratory. They have endeavoured to lighten my labours in connection with this discovery very much, and I am exceedingly grateful to them. To all to whom I have shown our patterns—amongst others, Professor Penny—they have exhibited the utmost surprise and pleasure at the beauty of the results. I shall be most happy at any time to send to any chemist desiring them the papers we use, as also patterns of different oils.

I sincerely trust that this little discovery of mine may be the humble means of imparting additional fame to a science of far-spreading light and intelligence.

PHOTOGRAPHY IN CONNECTION WITH THE ABYSSINIAN EXPEDITION.

By H. BADEN PRITCHARD,
(Of the General Photographic Establishment of the War Department.)

(Concluded from page 293).

With but few exceptions the chemicals and appliances were in first rate order, and worked almost without a hitch. In copying plans—an operation which was of course conducted in the open air—much difficulty was experienced from the breezes which blew almost incessantly in the vicinity of the mountains. Often the maps were blown right off the copying-table; and during exposure it was frequently necessary to keep brushing the dust and sand from the original, a proceeding which sometimes militated against the sharpness of the reproductions.

Work had to undertaken at all times, so that at any moment the photographers were ordered to fall out on the line of march, whatever might be the state of the weather, and the likelihood or possibility of success. When the duty had been performed, successfully or unsuccessfully, as the case might be, the boxes were packed, the mules saddled, and the head quarters caught up again as soon as possible. Paper was sensitised over night whenever a halt was made, about sixty sheets being prepared at a time, occupying the staff between four and five hours. Early in the morning the prepared paper was rolled in sheets of blotting-paper and stowed away, as far from the light as possible; and on arriving at the next encampment printing was at once commenced. After toning and fixing, the prints were washed for two or three hours, and if water happened to be plentiful, which was very seldom the case, the same was changed several times during the night. When the pictures were urgently required they received but an imperfect and hasty washing; but otherwise they were packed moist in blotting-paper and again washed on the first opportunity; when the prints dried in contact with the paper, the latter required to be carefully moistened before a separation was attempted, as pictures in this condition are very liable to injury. The squaring and mounting operations were performed without difficulty.

It will be a question in future operations of this kind whether, instead of printing the plans on paper and mounting them afterwards on linen, it would not be better for field purposes if they were produced direct upon the fabric. The material might be kept ready stiffened and albumenised; the sensitising and printing operations would not be more laborious or time-taking, and the amount of washing required would be very small, as the water readily permeates the fabric. The time gained by shortening the process of washing, and obviating altogether that of mounting, would be considerable.

A subject of regret is the fact that a great deal of useless work was sometimes performed on account of the ignorance of photographic matters on the part of staff officers who gave orders. This occurred the more frequently from the fact that Colonel Pritchard's command was so extensive that he was unable to give the photographers his undivided attention. Such a state of things would easily be avoided in future by sending an officer well skilled in photography in immediate charge of the party; it would then be possible to question the feasibility of an order upon its receipt, instead of vainly endeavouring to obey an impossible mandate, and wasting valuable time and materials unnecessarily. In many cases, in taking landscape pictures, a rough, imperfect sketch was frequently all that was required; but even this, under unfavourable circumstances, is sometimes quite as difficult to secure as a perfect picture. With soldiers there is, however, no appeal; and an order given must be obeyed—if possible. So sometimes the mules had to be halted and the boxes, unpacked during a long march in a drizzling rain in order that a picture might be attempted of some mountain or other, the top of which was enveloped in a dense fog, simply because a staff officer had expressed himself to the effect that the whole would make a grand picture.

The scarcity of water on the line of route was a serious evil; several negatives had frequently to be washed in the same water, and the prints fared no better. Besides, the water was in general badly adapted to photographic purposes, being very hard and full of chlorides, involving, therefore, great waste of silver in its employment; a distilling apparatus had been provided for purifying the water, but the latter was always so scarce, and time so pressing, that the still was rarely resorted to. From the fact that the majority of negatives taken were those of maps requiring a lengthened and more varied treatment than ordinary plates, in order to produce a film of considerable density, the want of an abundant supply of water was felt more seriously than would have been the case in ordinary manipulations.

On inspecting the landscape and other negatives taken by the chief photographer and his assistants, it will be seen that they include many creditable productions; and when we remember that not a single one of them was specially selected for the camera by the photographers themselves, and that the series of sixty negatives has not been weeded out, but represent the whole number produced to order, sometimes with the sun shining directly into the camera, sometimes when the sun had gone down, sometimes with the camera in the sun-light and the object to be reproduced in a covered tent, at most unseasonable times, at all hours, after long marches, and by men who had besides to perform the duties of soldiers,—I say when we bear in mind the circumstances under which the operators laboured, the work they have performed is highly commendable. There is, however, one more picture which should have been included in the set our friends have brought home, and which is eagerly sought for by every examiner of the sketches; its absence is regretted, however, by nobody so much as by Colonel Pritchard himself, who was indefatigable in his endeavours to obtain interesting subjects for the camera, but who was unfortunately wounded at the storming of Magdala, and therefore unable to perform any active duties for some days after the death of King Theodore. An order was sent down by General Napier to obtain a picture of the fallen chief, but owing to some delay the instructions were not given to the Engineers until after the interment; the authority for visiting the body reached Sergeant Harrold one hour too late, and thus has been lost all record of those features, a delineation of which by photography, even of the crudest description, would have been of great value. How eagerly should we all have scanned the portrait here, in England, in endeavouring to read from the lines and markings of the brow the character of the determined warrior we had vanquished!

However, we must be contented with the pictures we have, and there are some among them possessing deep interest. There is the conference tent at Durbagh, where the first meeting took place between Napier and Kassai; friendship was alleged, but treachery was feared, and accordingly we see upon the field the troops and guns drawn up ready for salute or for action; for it was deemed by no means improbable that within half an hour of the taking of that picture the landscape might be turned into a battle-field, and the labours of the photographers required for more serious purposes. There are the views of Magdala and King Theodore's house; of Selassee, the height stormed on the Good Friday, together with the rock from which the Emperor's big gun first opened fire; groups of the whole of the captives, who are now probably scattered all over Europe, and whom even within twenty-four hours of their liberation, it required some energy on the part of the operators to collect together to be photographed. Of the churches of Abyssinia, there are views of those at Addigerat, Magdala, Focada, and Antalo; pictures of Ashangi lake and of scenery on the banks of the Tellari, Taccazzee, Djedda, and Bashelo rivers, besides representations of all the principal points of interest and architectural curiosities met with.

On the whole, therefore, I think we can congratulate the Royal-Engineer photographers, and more especially Sergeant Harrold, on the manner in which they performed their arduous duties; to them the staff of the army was much indebted for information obtained and circulated by means of the camera, their labours forming no unimportant part of the cog-wheel of administrative machinery which, under the guidance of Sir R. Napier, worked so smoothly and surely; to them we at home are indebted for a clear conception of the nature of the country, for presenting to our view the various difficulties met with during the army's pilgrimage to release the prisoners, for giving us a true picture of King Theodore's stronghold, and for showing us what the inside of Magdala was like. And I feel sure you will agree with me in the opinion that if ever a silver medal has been well earned by a photographer, it is that which Sergeant Harrold now wears upon his breast, and which was specially awarded to him for distinguished services rendered in the field before Magdala.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 17th, 1868.

R. Angus Smith, Ph.D., F.R.S., Vice-President, in the Chair.

Mr. John Isaac Mawson, C.E., and the Rev. Brooke Herford, were elected Ordinary Members of the Society.

Professor William Jack, M.A., laid on the table Professor Tait's new work on Thermodynamics, presented to the Society (of which he is an honorary member) by the author.

He called attention to the estimation in which Professor Tait held the work of Dr. Joule in laying the foundations of the science. It was well known that the claims of Mayer to the first place in connection with the subject were strenuously advocated by some authors. Professor Tait considered those of Dr. Joule incomparably superior.

The equivalence of a definite quantity of work to a definite quantity of heat had been indicated as extremely probable by the experiments of Rumford; and Davy's celebrated experiment, in which he melted ice by friction, confirmed the view that work was really so convertible. Modifications of Rumford's experiments would have enabled him to present the heated body in nearly the same state after as before heating, except as regarded the increment of temperature. These, however, had not been made, and the experiments appear to have been neglected.

In all heating there are three mechanical results of work possible:—

1. That the particles of the body may be set into more rapid vibration.
2. That their distances may be changed by dilation or contraction, work being used up in accomplishing this change, just as when weights are raised against gravity, *i.e.*, when their distance from the centre of the earth is altered.
3. That any outside forces acting on the body—*e.g.*, pressures in the case of a gas—might have their points of application altered.

The two first are internal effects—the last external.

Mayer and Joule both of them applied the principle of the transference of heat into work to air compressed by work. With this substance Joule showed experimentally that the first two effects might be disregarded altogether in comparison with the third. Mayer assumed this without any proof, or apparently without an idea that he was making any assumption. The argument of Mayer was therefore only an ingenious speculation—Joule's was a complete proof.

Joule, however, went much farther than Mayer. He showed by frictional and electromagnetic experiments of the most varied kind that the supposed equivalence was an absolute law of nature, and he found means in all these cases to disengage the result from the complications to which we have referred, and to determine the definite amounts of work and heat which are equivalent to each other. He perceived and stated the principal applications of his discovery to the laws of chemical combination and vital action, and Professor Tait says:—"In all the scientifically legitimate steps which the early history of the principle records, Joule had the priority. The reader should clearly recognise the fact that the experimental foundation of the principle in its generality, and the earliest suggestions of many of its most important applications, belong unquestionably to Joule. Trained to accurate experiment and profound reflection in the school of Dalton, the pupil has not only immortalised himself, but has added to the fame of the master."

On the other hand, it appears to Professor Tait just to quote a passage in which Helmholtz, no doubt in view of Mayer's later work as well as that at the time of the foundation of the science of mechanical effect, thus expresses himself:—

"Mayer was not in a position to make experiments; he was repulsed by the physicists with whom he was acquainted (several years later I was similarly treated), and could scarcely procure room for the publication of his first compressed exposition. You must know that in consequence of these repulses his mind at last became affected. It is difficult now to transport oneself back into the circle of thought of that time and to perceive clearly how absolutely new the matter then appeared (25 years ago). It seems to me that even Joule had to struggle long for the recognition of his discovery.

"Thus, although no one will deny that Joule has done far more than Mayer, and that in the early writings of the latter many points are not clear, I believe that Mayer must be considered as a man who independently and for himself discovered this thought which has produced the grandest recent advance of natural science, and his deserts are by no means diminished by the fact that simultaneously another, in another country and sphere of action, made the same discovery, and indeed has since developed it better than he."

Mayer has many titles to the gratitude of scientific men, and one of the chief of them will no doubt always be his anticipation of the true doctrine of the equivalence of heat and work. But as it was founded on an experiment which was only sound by chance, in interpreting which he had not seen that his conclusion depended on one precise answer to a question that had not suggested itself to his mind, it was anticipation and not discovery. Dr. Joule remains the true founder of the modern science of Heat.

CORRESPONDENCE.

ATOMIC UNITS OF FORCE.

To the Editor of the Chemical News.

Sir,—We are continually protesting against the inconvenience of the English weights and measures, yet our men of science, who should lead the age, seem bent upon encumbering us with more burdens of the same nature. Is it not time now to ask why our scientific units of measurement should be different for every form of force, and especially why they should all be fixed on purely arbitrary data?

May I be permitted to suggest to those who have the power and influence to carry the idea into action, the immense advance which would be made by linking the idea of force to the atomic theory—by starting all the units at the relation of force to the atom of matter, instead of such purely arbitrary things as pounds, feet, grammes, and metres.

Thus, for heat, a variety of units are employed, all connected with definite measures of water; and they all show in different figures that, with exceptions which will no doubt one day be explained, every elementary atom of matter has the same specific heat. In Watts's Dictionary this is represented by about 6·5; in Wurtz, another unit gives 0·375, with variations resulting from inevitable errors of observation. If, instead of these figures, the specific heat of the atom was 1, the actual value of this 1 being ascertained, the true specific heat of all substances might be obtained by mere calculation on data which would soon be established as to the relations of various groups of substances to heat, and thus the interference of internal work would be readily measured by the difference of calculated and observed specific heats, while not only would all calculations be immensely simplified, but many hidden relations of heat and matter would become obvious.

The actual unit would naturally be the heat contained in, say, 1 gramme or 100 grains of hydrogen raised either 1° or from the freezing to the boiling heat of water; and water being the most practical standard, the actual value would be represented by the weight of water raised to that extent by this unit, and be capable of translation at once into any system of weights.

This unit would at once become that of every form of force; and instead of such units of mechanical energy as 772 ft.-lbs. or 425 kilogrammetres, the unit would be the force developed by the expansion of 1 atom of hydrogen under the influence of 1 unit of heat, doing away with all complicated calculations as to the conversion of heat into work, and being equally capable of translation into any system of weights and measures employed.

In electricity what complicated expressions would be swept away; the Farad to express a given quantity of electricity involves the consideration of force, resistance, and time; the new unit would simply be the current effecting decomposition of 1 molecule or releasing 1 equivalent of any substance, without reference to force, resistance, or the time occupied. The unit of electromotive force would be the same as the unit of heat or work into which it is convertible, and a suitable expression of it would readily be found; while the unit of resistance might be that against which a unit of force can pass the unit of quantity in a given time, or that in which a unit of force develops a unit of heat.

The intensity of chemical affinity would soon be brought under the same law, and it is evident that such a system would enormously simplify calculation, and furnish a new stand-point to all the physical sciences, giving a just and comprehensive view of their relations to each other, one as much wider and clearer than at present, as that which astronomers obtain by viewing the solar system from the sun as a centre, instead of from their own special observatory treated as the centre of the system; for the relations of gravitation, heat, electricity, light, chemical affinity, and mechanical work would be expressed by whole numbers instead of complicated decimals, and the simplicity which the atomic theory introduced into chemistry would be extended to all the phenomena of the universe.

If it is considered that present knowledge does not permit the value of the atomic unit to be correctly fixed, our scientific bodies could do no greater service than by carrying out a series of experiments on several elementary substances, and the simplicity of the relation of heat to gases would render the task an easy one while at the same time much practical knowledge would be gained during the process.—I am, &c.,

John T. Sprague.

MISCELLANEOUS.

The Royal Mining Academy in Berlin.—As this Mining Academy is a scientific institution of the first rank in Germany, the following notice concerning it may be interesting to the English scientific public:—The lectures of the Mining Academy are arranged in such a manner that a student may finish the complete course in two years; the students also enjoy the privilege of inspecting the different Prussian mining and metallurgical establishments during the vacations, and besides several times yearly they have the opportunity of excursions to those establishments in company of the professors. The lectures of the present half year, commencing on the 2nd of November last and ending on the 19th of March, 1869, treat of the following subjects:—

1. Mining Technology—five lectures weekly by Bergrath Hauchecorne; 15s. half-yearly.

2. Technology of Saltworks—one lecture weekly by Bergrath Hauchecorne; 3s. half-yearly.
3. General Metallurgy—four lectures weekly by Professor Kerl; 12s. half-yearly.
4. Metallurgy of Iron—four lectures weekly by Bergrath Wedding; 12s. half-yearly.
5. Founding and Moulding—three lectures weekly by Dr. Dürre; 12s. half-yearly.
6. Chemical Technology—two lectures weekly by Professor Kerl; 6s. half-yearly.
7. General Assaying—six lectures weekly by Professor Kerl; £1 7s. half-yearly.
8. Blowpipe Assaying—two lectures weekly by Professor Kerl; 9s. half-yearly.
9. Assaying of Iron—three lectures weekly by Bergrath Wedding; 13s. 6d. half-yearly.
10. Petrography—four lectures weekly by Dr. Laspeyres; 12s. half-yearly.
11. Geology, with special attention to the Stratified Formations—four lectures weekly by Professor Beyrich; 12s. half-yearly.
12. The Geological Formation of the Globe—one lecture weekly by Dr. Lossen; gratis.
13. On Volcanoes—one lecture weekly by Professor Roth; gratis.
14. Mineralogical Repetitions—four lectures weekly by Professor G. Rose; gratis.
15. Mineralogical Exercises—four lectures weekly by Dr. Eck; 12s. half-yearly.
16. Chemistry of Minerals—three lectures weekly by Professor Rammelsberg; gratis.
17. Repetitions of Analysis of Minerals—four lectures weekly by Dr. Finkener; gratis.
18. Practical Instruction in the Analysis of Minerals—(*a*), quantitative; five hours daily by Dr. Finkener; £3 half-yearly. (*b*), qualitative; four hours weekly by Dr. Finkener; £1 4s. half-yearly.
19. Analytical Geometry—five lectures weekly by Professor Bertram; 15s. half-yearly.
20. Mechanical Science—six lectures weekly by M. Hörmann; 18s. half-yearly.
21. Applied Mechanics—six lectures weekly by M. Hörmann; 18s. half-yearly.
22. Surveying of Mines—four lectures weekly by Berg-Assessor Kauth; 12s. half-yearly.
23. Instruction in Drawing—eight lessons weekly by Berg-Assessor Kauth; gratis.
24. Laws of Mines—two lectures weekly by Geh. Oberbergrath Ackenbach; gratis.

"The World of Wonders."—The first part of a new publication, issued by Messrs. Cassell and Co., the well-known popular publishers, entitled "The World of Wonders," certainly more nearly approaches the writings of the celebrated Baron Munchausen than any modern publication we are acquainted with. At the very time the bulk of the press is endeavouring to dissipate vulgar errors and sow the seeds of true physiological knowledge—the importance of which, in a medical point of view, cannot be too fully insisted on—we have in this cheap serial a collection of all the absurdities and historical monstrosities of the middle ages, for the enlightenment of the public mind. On one page is a picture of a mermaid and a merman; and though the opening paragraphs of the description mildly insinuate a doubt of the existence of such beings, the authentic (?) details, dating from 1187, 1430, and 1610, which are given at length, will go far to convince the non-sceptical mind of their truth. Again, on the very next page we find an article on "Wonderful Births," in which we have a *réchauffé* of all the old women's tales of multiparous women, winding up with the legend of Mrs. Bonham, who had seven children at one birth, all living, and all christened at the same font!—The "Wonders of Digestion" form the subject of another article, in which we are informed that the stomach is "a large bag, the whole of whose surface is covered with a series of tiny finger-like projections, from every part of which a thin fluid is pouring out"! The following we do not pretend to understand, and we should like to know what idea it will convey to the simple reader:—"As the chyle is absorbed it changes its character. First, the presence of fibrin begins to manifest itself; then it gradually becomes coloured, white corpuscles, apparently identical with those of blood, being formed in large numbers." The article in question concludes with an account of a juggler who passed a sword "too far down the *windpipe*" into his stomach, where it was nearly all dissolved, only "a foolish medical man ordered the conjurer horse exercise," which led to "a severe internal wound and death." "The Living Skeleton," "Wonderful Frosts," "A Wonder of Intrigue," "Wonderful Women," "Giants," all more or less flavoured with the apocryphal, are duly recorded; but perhaps the most "Wonderful" paper is one on "Wonders of Vegetation," with three illustrations of a turnip with a human face (grown in 1682), a radish in the form of a human hand (A.D. 1672), and a parsnip held by a lady's hand (of unknown antiquity). We wonder who the compiler of such a farrago of absurdities can be, and imagine that he must belong to the order of funny if not wonderful dogs which are not mentioned in the work—unless, indeed, we are suffering from the "optical *delusion*" recorded in large type in the same pages.—*Lancet.*

NOTES AND QUERIES.

Aluminate of Soda is, I believe, manufactured and sold by Messrs. Gaskell, Deacon, and Co., Lancashire—I believe at Widnes near Warrington.—*X. Y. Z.*

Blowpipe Apparatus.—Can you tell me the maker of the neat little moulds recommended by Mr. David Forbes, and mentioned in Mr. Crookes's edition of Mitchell's "Assaying," for blowpipe analysis? Also, does any manufacturer keep Plattner's pure charcoal mouldings in stock?—PER MARE PER TERRAM.

Fuming of Vapours.—I am not able to find out from the books why hydrochloric acid gas makes a visible cloud when let out in the air, and ammoniacal gas, which has a stronger attraction for water, does not. Perhaps some of your better-informed readers will enlighten me, and oblige—A STUDENT.

Writing on Gold.—A correspondent asks if there are any chemical means by which he can write an inscription on the back of a gold frame which is too thin to admit of engraving. He may do so by tracing the characters with a glass tube drawn to a fine point and dipped in aqua regia. After letting it rest a minute or two, he may wash the acid out and fill up with black varnish.—G. H. A.

Writing on Gold.—Your correspondent might try—1st, a pretty concentrated solution of bichloride of mercury in water, to which either some few drops of nitro-hydrochloric acid, or of chlorine water, had been added; 2nd, a strong and acidified solution of pernitrate of mercury; 3rd, a strongly acid, but not too concentrated solution of chloride of platinum. Each of these to be of course applied with a quill pen or finely-pointed glass rod, or a piece of stout and somewhat-pointed platinum wire.—A.

NOTICE.

With this number our present volume closes. We are glad to inform our readers that within the next few numbers we shall commence a verbatim report of Dr. Odling's Christmas Lectures at the Royal Institution "On the Chemical Changes of Carbon." The articles by David Forbes, F.R.S., "On the Application of the Blowpipe to the Quantitative Determination or Assay of certain Metals," will be continued. A series of original articles on the following subjects, by Dr. Fleischer, of Dresden, will also appear:—1. "On a New Convenient Filter for Chemical Analysis." 2. "Commodious and Exact Standard Solutions for Alkalimetric and Acidimetric Assays." 3. "Simple and Quick Determination of Copper in the Presence of all other Metallic Salts." 4. "On the Application of Constant Factors Facilitating the Calculation of Indirect Analysis." 5. "Simple and Exact Determination of the Oxides of Barium, Strontium, and of Lime in an Indirect Manner." A series of articles "On the Technical Analysis of Commercial Products," and papers by Professors Stas, Wöhler, Stanislas Meunier, and other eminent continental chemists, will also appear; whilst other new features will be gradually introduced into our pages during the ensuing year.

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